PROCEEDINGS OF A SPECIAL STUDY INSTITUTE
METHODS AND PROCEDURES FOR TRAINING LOW VISION SKILLS

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METHODS AND PROCEDURES FOR TRAINING LOW VISION SKILLS

PROCEEDINGS OF A SPECIAL STUDY INSTITUTE

Compiled and Edited by
Evelyn J. Rex

Department of Special Education
College of Education
Illinois State University
Normal, Illinois
1971

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PREFACE

The utilization of remaining vision is not a new concept to educators of the visually handicapped. Those educators who were instrumental in changing the names and practices of programs once known as "sight saving classes" or "sight conservation classes" were certainly aware of the importance of utilizing residual vision. Establishment of "classes for the partially seeing" was an early attempt on the part of teachers of the visually handicapped to guide children in their use of remaining vision. They were aided by other professionals -- ophthalmologists, optometrists, lighting engineers, biologists. It has now been accepted generally that visually handicapped children should make use of whatever amount of residual vision is available to them. The importance of guiding children in their use of remaining vision has become a philosophical tenet in the education of children classified as partially seeing and, in the case of most educators, philosophy has become practice.

A 1961 study by John W. Jones of the United States Office of Education revealed the large numbers of children classified as blind who were also using residual vision. Of children with 20/800 visual acuity, 50 per cent were print readers. Of children with notations of such meager visual acuity as CF (Counts Fingers), as many as 25 per cent were reading print.

The Jones study provided the field with several new concepts. Educators began to place less emphasis on visual acuity and became concerned with visual efficiency. The classification of blind and partially seeing as defined by visual acuity measures became ineffective and the dichotomy for classification became one of reading medium, print or braille. Even this second dichotomy has limitations for some children read both print and braille. The Jones study also provided the term "visually handicapped" for the classification of children with visual impairment severe enough to warrant special educational provisions.

Again, the role of ophthalmologists, optometrists and others must be recognized. Their contributions in the area of low vision aids have provided visually handicapped children with the means for both increased acuity and efficiency.

In 1963, influenced by the findings of the Jones study and by her own observations of visually handicapped children, Natalie C. Barraga did the original research

with children classified as blind but with remaining vision. Barraga's work showed that children with low vision could be trained to use that vision with a greater degree of efficiency. Barraga's work established the sequence for visual training and provided suggestions for activities and materials for the training. Barraga also developed an instrument for use in assessing visual efficiency.

In 1967, Ruth Holmes reported her research in the area of low vision. Mrs. Holmes replicated the Barraga research but used older children, junior high school level, in her study. The Barraga and Holmes research provided information which needed implementation in a program to train teachers of the visually handicapped, as well as implementation with children.

Illinois State University is one of several programs which prepares teachers of the visually handicapped. Implementation of the research and planning for the Institute reported in these Proceedings began with the completion of Mrs. Holmes' research, which was done as a part of her Master's Degree program at Illinois State University.

Each semester Mrs. Holmes visits the ISU campus for a presentation to students on the utilization of low vision. The students have an opportunity to observe and do some work with low vision children enrolled in the campus laboratory school. Students are assigned to Illinois Braille and Sight Saving School as student teachers, where they have an opportunity to observe Mrs. Holmes as she functions in the vision training program there. Those students assigned specifically to her do vision training under her supervision.

The program for teachers in training has great value. However, such a program makes no provision for the many teachers who were trained earlier. One major responsibility of a university is to provide in-service training. In the fall of 1969, plans for an Institute on Low Vision were proposed and submitted to the U.S. Office of Education. A two-week Institute was funded under Public Law 85-926, as amended, and was held on the campus at Illinois State University July 13-24, 1970.

Sixteen participants were selected for the Institute. They were chosen from the Middle West since other applicants had an opportunity to attend other regional workshops. There was an attempt to select persons representative of the various educational roles in the field of the visually handicapped. Among the participants were teachers from both residential and day programs, teachers of blind and partially seeing children, teachers at elementary and secondary levels, a mobility instructor and a program supervisor.

The Institute provided an opportunity to study many aspects of low vision -- eye diseases resulting in low vision, low vision aids, lighting, sensory and perceptual functioning of the low vision child, and methods and materials used in training the child to utilize his low vision. A theoretical background was provided through lectures, demonstrations, discussions, professional reading, and preparation of a paper. A highlight of the Institute was an opportunity to make practical application of theory. Nine low vision children were brought to the campus and a one-week diagnostic-teaching center was established. Each participant received two semester hours of credit.

All of the presentations of the Institute were audio taped for future use. Many of the presentations and sessions were also video taped. These taped presentations provided the basis for the present Proceedings which are a report of the activities of the Institute. The various sections of the Proceedings reflect an informal and personal manner which was the tenor of the Institute.

Unknown at the time that plans for the Institute were developed, it was to become part of a national training program in the area of low vision. Dr. James Moss, Director of Research, Bureau for the Handicapped, USOE, had expressed concern that the findings of research studies were not being implemented in the classroom. Dr. Barraga's research was an example of such a lag. Dr. Moss proposed a major national effort to combat such a situation and selected the area of low vision as the first area of emphasis. A committee chaired by Miss Josephine Taylor, Coordinator of Training Programs, Area of the Visually Handicapped, Bureau for the Handicapped, planned a series of three day regional workshops to train teachers to guide children in the utilization of low vision. The first workshop prepared the directors and instructors of future sessions. The American Printing House for the Blind prepared a bibliography, a materials list and several tangible aids. The original instrument for the assessment of low vision was revised and the Visual Efficiency Scale is now available for use with children with low vision. Illinois State University is proud to have had a role in such an undertaking and is pleased to present these Proceedings of its Institute on the Methods and Materials for Training of Low Vision Skills.

Evelyn J. Rex, Ph.D.
Associate Professor of Education
Illinois State University
Normal, Illinois

June 1970

ACKNOWLEDGEMENTS

Many persons contributed to the success of the Institute. The contributions of Mrs. Holmes and the consultants are present in these Proceedings. Their contributions far exceed their presentations and the help they provided the editor. Their personal contributions are gratefully acknowledged.

The attendance, interest and enthusiasm of the participants provided the motivating force for the Institute. They were, indeed, a select group.

A special acknowledgement must go to all those persons who took responsibility for the care of the children during the five days they were in attendance. Illinois Soldier's and Sailor's Children's School provided the physical facilities for the children. Mr. Charles McAnally and other staff members at ISSCS provided time, encouragement and support. Karen Linsey, Cathy Bartell Hula and Edith Koffler excelled in their roles as counselors. Mr. Kenneth Corcoran of the ISU summer staff directed recreational activities for the children.

Mr. James Meeks of the Instructional Materials Center for the Visually Handicapped in Illinois taped the activities of the Institute. Mr. Russell Trowbridge, graduate student in visually handicapped, helped in the final editing of both audio and video tapes.

The secretarial staff of the Department of Special Education provided service over many months, from the preparation of the proposal for the Institute to the final typing of these Proceedings. The University Press prepared the final copies.

The support of Dr. Harold R. Phelps, Chairman, the Department of Special Education, and Mrs. Fran Dodson, Program Administrator, is much appreciated.

The Institute could not have been held without the financial support of the United States Office of Education. That support is gratefully acknowledged.

Finally, special recognition must go to the nine children who shared the last days of the Institute with us. It is to them and other low vision children that these Proceedings are dedicated.

METHODS AND PROCEDURES FOR TRAINING LOW VISION SKILLS
July 13-24, 1970

MONDAY, July 13

9:00-10:30	Registration	
	Welcome	Dr. Evelyn Rex, Associate Professor, Department of Special Education
		Dr. Dennis D. Bell, Associate Dean, College of Education
		Dr. Harold Phelps, Chairman, Department of Special Education
	Introduction of Participants	
	Break	
10:30-11:30	Purpose and Philosophy - General Introduction	
1:00-3:00	Philosophy, History, and Research Concerned with Training Techniques for Utilization of Low Vision - Mrs. Ruth Holmes	

TUESDAY, July 14

9:00-11:30	Definition of Low Vision Visual Examination Routine Refraction as it Applies to the Low Vision Child Low Vision Aids Dr. Dennis Farrar, Assistant Professor of Optometry, Illinois College of Optometry, Chicago, Illinois

1:00-3:00	Administration and Coordination of a Training Program in a Low Vision Clinic Mrs. Nancy Fagerstrom, Administrative Assistant in the Low Vision Clinic, Chicago Lighthouse for the Blind, Chicago, Illinois
WEDNESDAY, July 15	
9:00-11:30	Light and Lighting for the Visually Handicapped Dr. Sylvester K. Guth, Manager of Applied Research, General Electric Company, Nela Park, Cleveland, Ohio
1:00-3:00	Methods and Materials with Low Vision Children - Ruth Holmes
THURSDAY, July 16	
9:00-11:30	The Total Visual System - Developmental Aspects of Functional and Perceptual Visual Abilities (Lecture and Discussion) Dr. Natalie C. Barraga, Program Coordinator, Area of Visually Handicapped, Department of Special Education, University of Texas, Austin, Texas
1:00-3:00	Attitudes and Psychological Factors - Basic Principles of Training Activities (Lecture and Discussion) Dr. Natalie C. Barraga
FRIDAY, July 17	
9:00-11:30	Assessment of Visual Functioning Level and Development of Prescriptive Models for Activities with Low Vision Children (Lecture and Discussion) Dr. Natalie C. Barraga
1:00-3:00	Video Tape - An Appraisal of Visual Efficiency - Discussion

MONDAY, July 20

9:10-10:45	Anatomy of the Eye (Summary and Review) Dr. Arthur Merrick, Professor of Physiology, Illinois State University
11:00-11:30	Division of groups and assignment of children
1:00-2:00	Preparation of materials
2:00-3:00	Work with the children

TUESDAY, July 21

9:00-10:00	Physics of Refraction - Implications for Education of Visually Handicapped Dr. Arthur Merrick
10:00-10:30	Break and preparation for children
10:30-11:00	Work with the children
1:00-2:00	Diseases of the Eye as Related to Low Vision (Summary and Review) Dr. Arthur Merrick
2:00-3:00	Work with the children

WEDNESDAY, July 22

9:00-10:00	Library time - Preparation of materials
11:00-11:30	Work with the children
1:00-1:45	Discussion and evaluation of progress with the children Comparison of notes
1:45-2:00	Break and preparation for students
2:00-3:00	Work with the children

THURSDAY, July 23

9:00-10:00	Work with the children
10:15-11:30	Role of the Teacher Mrs. Ruth Holmes
1:00-2:00	Work with the children
2:00-3:00	Complete reports

FRIDAY, July 24

9:00-11:30	Discussion Evaluation and Summary

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HISTORY, PHILOSOPHY AND RESEARCH CONCERNED WITH TRAINING TECHNIQUES FOR UTILIZATION OF LOW VISION

Introduction to the Institute

Mrs. Ruth Holmes, Teacher
Illinois Braille and Sight Saving School
Jacksonville, Illinois

Have you ever given any thought to how great it has been to play a contributing role in the education of the visually handicapped during the last decade? The changing philosophies and increasing numbers of special materials have nurtured much growth and development in the field. There is a constant search to meet the demands of specific needs. This presents a tremendous challenge to us as educators. Jones and Collins, in reviewing educational programs for the visually handicapped, note that modern emphasis on the development of visual perception and sight utilization makes it essential to understand the optical aids and teaching techniques which help the child make maximum use of residual vision.

According to leading ophthalmologists such as Fonda, Bier, and Sloane, using the eyes does no harm regardless of the distance at which reading matter is held. Use of vision, no matter how little, is the privilege of every child who has any sight.

Many times visual behavior seems to govern behavior in general. The child with low vision, within the confines of the legal definition for the blind but with residual vision which might be useful to him, should be allowed to develop his visual ability to its greatest potential. This enables the child to enhance and extend his tactile and braille skills or his limited visual skills - whichever he depends upon.

As we teachers watch students who like to use their limited visual ability, though they may live primarily in a tactile world, a need to help them understand and use this ability within the bounds of their limitations becomes apparent to us. By way of illustration, let me tell you of a student who was "the bad boy of the school." He could read braille with his eyes, seemed always to be using his limited vision, but allowed the pressure of his peer group

and pressure from his parents to keep him "blind." As he approached adolescence, he was afforded an opportunity to participate in a vision training program. This seemed to help him understand his visual problems, how to use what vision he had as adequately as possible, and when to use it. He did not forget or put his braille skills aside, but used his visual ability to enrich his study wherever possible. He changed his behavioral pattern in a comparatively short time and graduated four years later with a much improved scholastic record and a definite purpose in life.

There was the boy who was classified legally blind with 20/400 clinically measured distance visual acuity in one eye. The eye also had central corneal scars. There was no vision in the other eye. He had a visual curiosity about everything and read well in large type books. On the other hand, students with more measured acuity were existing as totally blind.

The example given by Margach when speaking of his work with spatial perception is a good example. There were two boys with identical measured central visual acuity at 20/300, both legally blind. The one, upon entering the clinic reception area, did not travel alone when there was anyone to be depended upon. As he was forced to depend upon himself, his path became cautious, exploratory, shuffling with hesitant gait. The other boy was much more sure of himself and when asked for his favorite form of recreation replied, "Skiing." The peripheral fields of vision were identical but it was noted that the speed of response to periphery objects was slower in the first boy.

These examples seem to indicate that visual behavior and visual function differs in individuals, though visual acuity measures may be similar for indicating legal blindness. They also point to the fact that curiosity, training, experiential background, and other things may contribute to the ability of the person with limited vision to function adequately or inadequately with that vision.

For common understanding, let us define some terms. Since you have had training and experience in the field, you are familiar with such terms as "legal definition" and "visual acuity measure." Residual vision refers to any amount of useful remaining vision greater than total blindness. It may or may not be measurable. Low vision is any amount of useful vision greater than total blindness and classified blind. It may be arranged in various categories according to measured visual acuity. Jones used

such categories in 1960 based on the Federal Registry Data on Legally Blind School Children. His study was replicated by Nolan in 1963, 1966 and again in 1969. Statistics in the last study indicate that 79 per cent of the children classified as "blind" for legal purposes have potentially useful vision. The visual acuity in low vision seems to be a variable as an indication of measurable vision as compared to normal visual acuity. It is based on the physiological function of the eye itself.

One must include the entire visual process when speaking of the ability to see or "learning to see." This encompasses visual perception. As reported by Barraga, visual perception is the ability to receive visual sensations, code them, organize them, and make a decision so that recognition and classification for response may be made. Visual perception is a physio-cognitive function, dependent more on learning and intellectual capacity than on the physical medium of the eye. According to Piaget perception is developmental in nature, which is to say that it changes significantly with age through the interaction of maturation and experience.

Visual efficiency is a measure of performance. It is determined by the degree of success, speed, accuracy, and ease with which the response is made after a stimulus is channeled through the eye into the brain for interpretation. Psychological and emotional factors can also have some influence on the degree of efficiency where low vision is concerned.

Dr. Natalie Barraga has been a pioneer in the area of development of residual vision. She initiated a study in 1963 which was designed to determine if the visual behavior of blind children having remaining vision could be significantly improved by a short period of specialized instruction with appropriate materials. A Visual Discrimination Test was developed for the study. It was validated and the evaluation for reliability proved to be high. It was used as a pre-test and post-test for the subjects in an experimental group and a control group. The subjects of the experimental group were subjected to a period of experimental teaching which followed a sequential pattern of fixation, tracking, realization of form, outline and specific details. The test scores of the experimental group were significantly higher following the period of experimental teaching, indicating that stimulation and practice bring about a greater degree of efficiency.

The original research was replicated by Ashcroft, Halliday, and Barraga. Both studies used students who had been trained as braille students with no formal training of any kind as to use of their residual vision. There were 24 subjects from ages 6 to 13 years. The results indicated a significant increase in visual functioning, as indicated by the Visual Discrimination Test designed by Dr. Barraga.

I conducted a similar research project at the junior high and high school level. As I had studied Barraga's findings, I wondered if the older student who had been educated as a braille student (but with residual vision) could also function more efficiently following a period of individualized teaching that used the sequential pattern set forth by Dr. Barraga, with appropriate materials for this level. Additional items were developed to raise the level of the Visual Discrimination Test. Both tests were used and performance on both indicated a highly significant increase in visual function, following experimental teaching.

In the ensuing years, some applications of this research were made as in the Visual Stimulation Program under the direction of Rosemary O'Brien in Montgomery County, Maryland. It became evident that much support was needed in the way of materials and methods in order that this type of training could be made available to the children with specific needs throughout the country.

Such an effort was initiated last December at the Austin Conference on Utilization of Low Vision. A coordinating committee met as directed by Dr. James Moss of the Bureau of Education for the Handicapped, United States Office of Education. Miss Josephine L. Taylor, Coordinator, Units on the Visually Handicapped, Multihandicapped, and Interrelated Division of Training Programs, served as Chairman. With the cooperation of the American Printing House for the Blind Research Department and the Instructional Materials Reference Center, a kit was devised which contains a Teacher's Guide for Development of Visual Learning Abilities and Utilization of Low Vision, a Visual Efficiency Scale with directions and a profile sheet, and a Bibliography and Materials List. The list includes the names and addresses of the sources for all materials listed.

After the Scale has been administered, a profile is developed. The profile sheet serves to point out strengths and weaknesses or areas of efficiency and deficiency in the visual functioning of the child, since it lists and classifies various types of visual behavior. From this, with

help from the Teacher's Guide, a program of visual stimulation can be derived so that the individual needs of a child can be met.

The lessons themselves follow a sequential pattern, working from gross and simple to the more complicated with finer detail, and from the larger to the smaller. The sequence according to Dr. Barraga follows a pattern of noting likenesses and differences, classification, matching, ordering, grouping and relating, discrimination of missing parts, integration, reorganizing, labeling, and categorizing.

Ability to read print is not necessarily the goal of vision training, nor is the goal to change the mode of reading. This type of training merely enhances the educational development of the child, allowing him extended opportunities for learning. If he can handle both print and braille, that should be his choice to make and not ours to make for him. One boy subjected to this kind of instruction used a print book for math which seemed to be easier for him to handle than the braille. He used braille for general reading, but on occasion substituted large type books. He was able to use his visual skills on a summer job, noting himself that this training had been a great help to him. His negative attitude seems to be improving.

During the next two weeks, we shall try to develop a greater understanding of the whole visual process and how low vision may be stimulated, so that the student involved may function as efficiently as possible within the confines of his physical limitations. We should not lose sight of the fact that we are dealing with a "whole child" and that anything which might help the child to be a better person in his own individual world is his right.

ANATOMY OF THE EYE - A SUMMARY

Dr. Arthur West Merrick
Professor of Physiology
Illinois State University
Normal, Illinois

(Note: During this presentation, Dr. Merrick used a model of the skull and presented figures from Wolff's Anatomy of the Eye, 6th edition. The lecture is presented in outline form with the expectation that such a format will enhance its use for future reference.)

1. Bony orbit

   A. General anatomy

      1. Two orbital cavities on either side of mid-vertical line of skull between cranium and skeleton of face.
      2. Fossa boundaries:
         a. Above - anterior cranial (and frontal sinus).
         b. Medial - nasal cavity and air sinuses.
         c. Below - maxillary sinus.
         d. Lateral - middle cranial and temporal fossae.
      3. Socket for eyeball:
         a. Contains muscles, nerves, and vessels.
         b. Transmits certain nerves and vessels to facial areas.
      4. Seven bones make up orbit:
         a. Maxilla
         b. Palatine - orbital and sphenoid parts
         c. Frontal
         d. Sphenoid
         e. Zygomatic
         f. Ethmoid
         g. Lacrimal
      5. Orbit is quadrilateral triangle.
         a. Apex is optic foramen (or medial end of superior orbital fissure).
         b. Base (and axis) is forward, lateral, and slightly downwards.
         c. "Pear-shape" with stalk at optic canal.
         d. Medial walls are nearly parallel; lateral walls about 90° angle with one another.

   B. Orbit roof (vault)

      1. Triangular shape; usually smooth; some aperatures for veins (most pronounced in fetus or infant); grooves, made by nerves and vessels.

2. Formed by:
    a. Orbital plate of frontal bone.
    b. Behind this, lesser wing of sphenoid.
3. Parts:
    a. Fossa for lacrimal gland (behind zygomatic process).
    b. Lacrimal gland and orbital fat.
    c. Smooth to pitted (suspensory ligament).
4. Structure:
    a. Roof - very thin, translucent, fragile; thicker (3 mm) at lesser sphenoid wing.
    b. Puncture wounds, fractures (easily).
    c. Frontal sinus (varies in size).

C. Orbit medial wall

1. Not triangular (only wall that is not); oblong, flat or slightly convex toward cavity.
2. Parts:
    a. Frontal process of maxilla.
    b. Lacrimal bone.
    c. Orbital plate of ethmoid (largest; light area - partitions; dark area - air cells).
    d. Part of sphenoid.
3. Contains:
    a. Lacrimal fossa
        1. Anterior
        2. Posterior lacrimal crests.
    b. Naso-lacrimal canal.
    c. Lacrimal tubercle.
4. Structure:
    a. Thinnest wall of orbit (0.2 - 0.4 mm).
    b. Translucent - can see air cells.
        1. Susceptible to infection.
            a. Ethmoiditis commonest cause of orbital cellulitis (inflammation).

D. Orbit floor

1. Triangular (like roof).
    a. Slopes downward from medial surface.
2. Parts:
    a. Orbital plate of maxilla (largest).
    b. Orbital surface of zygomatic.
    c. Orbital process of palatine.
3. Contains:
    a. Infraorbital groove (sulcus)
        1. Runs posteriorly into:
            a. Inferior orbital fissure (and suture).
        2. Runs anteriorly into:
            a. Infraorbital canal (covered by infra-orbital suture).

1. Can trace suture to infraorbital foramen.
2. Transmits infraorbital vessels and nerve.
3. Gives off dental canals (for vessels and nerves).

4. Boundaries:
   a. Medial - maxillo-ethmoid suture.
   b. Lateral - inferior orbital fissure.
5. Below:
   a. Maxillary sinus
      1. Possibility of infections, tumors.

E. Orbit lateral wall

1. Triangular shape
2. Parts:
   a. Posterior - orbital plate of greater wing of sphenoid.
   b. Anterior - orbital surface of zygomatic bone.
3. Structures:
   a. Most exposed to injury; thickest of all orbital walls; thins out in posterior area (medial cranial fossa behind).
   b. Lateral orbital tubercle (ligament attachment).
   c. Lacrimal gland reaches <u>down to</u> lateral wall.

F. Superior orbital fissure

1. Between roof and lateral wall; forms the gap between greater and lesser wings of sphenoid; lateral is frontal bone.
2. 22 mm long.
3. Largest communication between orbit and middle cranial fossa.
4. Pathway for many nerves and vessels.

G. Inferior orbital fissure

1. Between lateral wall and floor.
2. 20 mm long.
3. Closed anteriorally by zygomatic bone.
4. Pathway for many nerves and vessels; anterior end largest.

H. Optic foramen (canal)

1. Apex of orbit - from middle cranial fossa.
2. Transmits optic nerve, ophthalmic artery.

I. Orbital index (of Broca)

1. OI = hgt. of orbit x 100 / width of orbit.

2. Three classes:
   a. Megaseme (large)
      1. OI = 89+ (yellow races; orbital opening is round).
   b. Mesoseme (intermediate)
      1. OI = 83-89 (white races; quadrilateral).
   c. Microseme (small)
      1. OI = 83 or less (black races; orbital opening is rectangular).
3. Age and sex changes
   a. Orbit changes depend upon cranium and skeleton of face growth, sinuses growth).
   b. Margins sharp at birth (sharper in female); eyes well protected at parturition.
   c. OI high in child; become quadrupled about 7 yrs. of age.
   d. Interorbital distance may be small; may appear to squint when one has strabismus (makes eyes look close together).
      1. Disappears with growth of frontal and ethmoidal air cells.
   e. Senile changes - due mostly to bone absorption.

2. Appendages of the eye

A. Eyelids, eyebrows, conjunctiva, and lacrimal apparatus.

B. Eyelids

1. Movable folds (curtains).
2. Protect eyes from injury, excessive light.
3. When closed, visual cortex (only) can rest.
4. Perform a dual function re: tears:
   a. Blink, upper lid acts as a swab to spread film of tears over cornea (initiated by evaporation and dryness of cornea).
   b. Excessive tears - blinking empties the (potential) conjunctival sac by "pumping action" on lacrimal sac.
5. Upper eyelid extends above to the eyebrow (separates it from forehead); lower passes into skin of cheek.
   a. In aged, naso-jugal furrow and malar furrow just below inferior orbital margin ("escaped orbital fat" also).
6. Upper more movable; due to elevator muscle (levator palpebrae superioris); covers upper part of cornea with eyes open, entire cornea when eyes are closed.
7. Lower only slightly free of cornea when eye is open; rises only slightly when eye shut.
8. Eye open - palpebral fissure (elliptical space) between eyelid margins; these meet in the medial and lateral angles (canthi) of eye.

a. Lateral angle - continuous with groove which passes laterally and downwards ("crow's foot" or furrows).
b. Medial angle - separated from globe by a little bay or lake (lacus lacrimalis) which contains the elevated, yellowish body (caruncle) and laterally, a reddish fold (plica semilunaris).
    1. Caruncle
        a. 5 mm x 3 mm.
        b. Skin, contains large modified sweat glands, and sebaceous glands that open into hair follicles.
        c. Epicanthus
            1. Condition in which caruncle is hidden by fold (Chinese, Japanese, congenital ptosis, etc.).
            2. Occurs normally in human fetus and disappears with development of bridge of nose.
    2. Plica semilunaris
        a. "Third eyelid" (nictating membrane of lower animals).
        b. Contains muscle tissue.
        c. Part of conjunctiva.
        d. At a point in the lids (corresponding to plica semilunaris) is small elevation, papilla lacrimalis, the center of which is pierced by hole, punctum lacrimale (carries tears to nose).
c. Hence, when eye is open, can see:
    1. Cornea, iris, pupil, small triangle of sclera to lateral side, caruncle, and plica semilunaris.

9. Eyes turn <u>up</u> at approach of danger:
    a. Hence, center zone just below cornea is most exposed region (and common site of congestive or degenerative changes, and injuries due to burns and caustics).

10. Free margin of lids:
    a. 2 mm broad.
    b. Anterior border - eyelashes (stiff hairs), in 2-3 rows.
    c. Upper are longer, more numerous, curl upwards; lower curl downwards (no interlacing when closed).
    d. Eyelashes usually darker than hair; do not become gray with age (unless alopecia - inflammatory loss); longest and most curled in childhood; richly supplied with nerves; each remains about 5 months (10 weeks to grow to full size).
    e. Posterior border - against globe.
        1. Just in front, see small orifices of tarsal glands (Meibomian glands) - sebaceous function.

11. Structure:
    a. A series of layers placed one in front of the other (like leaves of a book) - from anterior to posterior:
        1. Skin.
        2. Layer of subcutaneous areolar tissue.
        3. Layer of striped muscle (orbicularis oculi).
        4. Submuscular areolar tissue.
        5. Fibrous layer - includes tarsal plates.
        6. Layer of unstriped muscle.
        7. Conjunctiva (mucous membrane).
    b. Skin:
        1. Thinnest in body (less than 1 mm).
        2. Forms folds, easily wrinkled, transparent, elastic.
        3. Attached at canthi (medial and lateral palpebral ligaments).
        4. Sweat glands numerous and small in size.
        5. Contains large pigment cells (rare elsewhere) - pigment golden to brown, more numerous in brunettes than blondes.
    c. Subcutaneous areolar layer:
        1. Loose connective tissue; no fat.
        2. Absent at palpebral furrow; also at lateral and medial angles as skin is adherent to palpebral ligaments.
    d. Striated muscle layer:
        1. Orbicularis oculi (palpebral portion) - fibers are concentric around palpebral opening.
            a. Part of this muscle occupies the entire lid margin (ciliary part) - is called Muscle of Riolan.
    e. Submuscular areolar tissue:
        1. Between orbicularis muscle and tarsal plate.
        2. May be traversed by fibers of levator muscle.
        3. Zone for local anesthesia (main eyelids nerves here).
    f. Fibrous layer:
        1. Framework of the lids.
        2. Consists of:
            a. Tarsal plates (thickened central portion):
                1. One per lid.
                2. Gives shape and firmness.
                3. Fibrous, elastic tissue; not cartilage.
                4. Extremities are attached to orbital margins by medial and lateral palpebral ligaments.
                    a. Medial palpebral ligament

1. Attached to frontal process of maxilla
2. Lower border free; upper continuous with periosteum.
3. At anterior lacrimal crest, it divides into anterior and posterior portions (specific anatomy).

b. Lateral palpebral ligament
1. Attached to orbital tubercle on the zogomatic bone.
2. Less strong, less well-developed than medial ligament.

b. Septum orbitale (palpebral fascia):
1. Thinner more peripheral part.
2. When eyes are shut, entire layer forms septum to the orbital opening.
3. Continuous with tarsal plates.
4. Movable, not fixed.

g. Unstriped muscle layer:
1. Muscle of Muller.
2. Stimulation (action) - widens palpebral fissure (SNS).

h. Conjunctiva:
1. Palpebral conjunctiva (lines lids).
2. Firmly adheres to tarsus.

12. Glands of lids:
a. Meibomian (tarsal) glands.
1. Long sebaceous glands; take place of row of lashes.
2. Larger in upper lid; also more numerous (25 to 20).
3. Each has central canal - sebum secreted into canal to prevent overflow of tears, to make an airtight closure of lids, to leave thin film of oil over moistened cornea (to delay evaporation).
4. Seen through conjunctiva as yellow streaks.

b. Moll glands.
1. Ciliary glands; form of a sweat gland.
2. Unbranched; may empty into duct of Zeis' gland.

c. Zeis glands.
1. Modified sebaceous glands; keep eyelashes oily.
2. Two per lash.

13. Intrinsic muscles and their functions:
a. Orbicularis oculi:
1. Sphincter muscle of eyelids.
2. Elliptical sheet, surrounds palpebral fissure; spreads out to forehead, temple, cheek.

3. Two parts:
    a. Palpebral
        1. Confined to lids.
        2. Function - <u>to close lids</u> (without effort).
        3. Opposed by levator palpebrae superioris.
    b. Orbital
        1. Helps form eyebrows (re: insertion).
        2. Function - <u>to close eyes</u> (tightly).
        3. Muscle of Merkel and Muscle of Henle - parts.
        4. Opposed by occipito-frontalis muscle.
        5. Used: crying children, coughing, blowing nose, sneezing, excessive laughing, etc.

b. Horner's muscle:
    1. Arises behind lacrimal sac near top of posterior lacrimal crest.
    2. Divides into 2 slips (lower becomes Muscle of Riolan, but eventually becomes continuous with orbicularis oculi).
    3. Forms deep portion of orbicularis oculi.

c. Frontalis muscle:
    1. Medial part of orbit as well as frontal.
    2. Function - <u>raises eyebrows; draws scalp forwards; "wrinkling" of forehead</u>.
        a. The <u>muscle of attention</u> (surpise, fear, horror, admiration, etc.)
    3. Opposed by occipitalis muscle (draws scalp forwards).

d. Corrugator supercilii:
    1. Medial side of eyebrow under frontalis & orbicularis.
    2. Function - <u>pulls eyebrows toward root of nose</u>.
        a. The <u>muscle of trouble</u> (frown, pain, sorrow, etc.).
    3. Well-developed in farm children (protects eyes from glare of sun).

C. Eyebrows

1. Elevation clothed with hairs.
2. Has five separate layers (skin, subcutaneous tissue, layer of muscles, submuscular areolar layer, and pericranium.)

D. Conjunctiva

1. General
    a. Thin, transparent mucous membrane.
    b. Attaches eyeball to lids.

c. Forms a (potential) sac - conjunctival sac (eyes shut).
d. Three parts - all continuous with each other.
1. Palpebral portion - lines lids.
2. Fornix - circular cul-de-sac.
3. Bulbar portion - clothes eyeball (the "sclera" of eye shows through it).
e. Structure - like all other mucous membranes (consists of two layers - epithelium and substantia propria).
f. Contains many (named) glands.

E. Lacrimal apparatus

1. Consists of lacrimal gland, tears, puncta (elevation is the papilla lacrimalis), lacrimal canal, lacrimal sac, and nasolacrimal duct.
2. Tear flow:
a. Lacrimal gland - to upper fornix - descend to upper lid margin - to upper punctum (limited by sebaceous secretion from tarsal glands) - does not flow across eye - to lacrimal canal and is aided by "sucking action" on lacrimal sac by orbicularis oculi - to lacrimal sac - expelled into nasolacrimal duct by elasticity of lacrimal sac - opens into inferior meatus of nose.
3. Lacrimal gland:
a. Two portions - orbital (anterior and lateral part of orbit roof) and palpebral (separated from orbital by levator palpebra), which is 1/3 size of orbital portion.

3. Extrinsic muscles of the eye:

A. Six in number
1. Superior, medial, inferior, and lateral recti and superior, inferior obliques.
2. Insert into sclera by glistening white tendons with some elastic, parallel fibers.

B. Structure
1. More highly differentiated than any other muscles in the body.
2. Receives great number of nerve fibers.

C. Actions:
1. Movements take place around three primary axes which pass through center of movement (and at right angles to each other).
a. Vertical axis around which the:
1. Center of cornea moves laterally (abduction) or medially (adduction).

b. Transverse axis from:
   1. Right to left and cornea moves either up (elevation or sursumduction) or down (depression or deosursumduction).

c. Sagittal (antero-posterior) axis:
   1. "Wheel-rotation" - intorsion or extorsion.

D. Origin, insertion:
   1. All originate from a tendinous ring (Zinn) near optic foramen except the inferior oblique (originates on orbital plate of maxilla at front of orbit); all insert on sclera (by tendons).

E. Actions, innervations:
   1. Superior rectus
      a. Sursumduction, intorsion rotation.
      b. Only muscle of sursumduction in abduction.
      c. III cranial nerve; longest rectus muscle (40 mm).
   2. Medial rectus
      a. Pure adduction.
      b. III cranial nerve; largest ocular muscle.
   3. Inferior rectus
      a. Deosursumduction, extorsion rotation.
      b. Only muscle of deosursumduction in abduction.
      c. III cranial nerve; shortest rectus muscle.
   4. Lateral rectus
      a. Pure abduction.
      b. VI cranial nerve.
   5. Superior oblique
      a. Deosursumduction, intorsion rotation.
      b. Only muscle of deosursumduction in adduction.
      c. IV cranial nerve; longest ocular muscle (passes forwards to trochlea (pulley) which is attached to frontal bone; forms trochlear angle here of 55°, passes under superior rectus).
   6. Inferior oblique
      a. Sursumduction, extorsion rotation.
      b. The only muscle of sursumduction in adduction.
      c. III cranial nerve; acts with superior rectus.

F. Levator palpebrae superioris
   1. Origin and insertion:
      a. Originates from the under surface of lesser wing of sphenoid and in front of optic foramen; passes forwards on superior rectus and ends as aponeurosis to insert to skin of upper eyelid.
      b. Has two "horns" at points of insertion - lateral horn passes between orbital and palpebral portions of lacrimal gland and attaches to lateral palpebral ligament; medial horn is attached to medial palpebral ligament.
   2. III cranial nerve.
   3. Action - to raise upper eyelid.
      a. Antagonist is palpebral portion of orbicularis.

BASIC INTERNAL ANATOMY AND PHYSICS OF REFRACTION - IMPLICATIONS FOR THE EDUCATION OF THE VISUALLY HANDICAPPED

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It is my intent to discuss briefly the general anatomy of the eye. The illustrations are from The Human Eye by Kronfeld, McHugh and Polyak; Bausch and Lomb Press, 1943. Here is the horizontal section of the eye. You will recall, there are three layers. The first or outer layer is the sclera which primarily is a protective layer, is transparent, and comes around to the front of the eye to become the cornea. The middle layer is the choroid layer and is the layer in which the blood vessels (veins and arteries) are found, so it is the vascular layer. The internal layer is the retina made up of the rods and cones. It is the nervous layer. Take a close look at the anterior to the posterior, or back, of the eye and observe a few structures. The cornea, of course, is covered by the conjunctiva. It is a very thin membrane layer across the front of the cornea which is perhaps half a millimeter in thickness. As it gets to the corneo-scleral junction, it becomes thicker, perhaps a millimeter or so. Directly posterior to the cornea are the anterior and posterior chambers, both of which are filled with an aqueous humor (a watery fluid). The oxygen in the aqueous humor is utilized by the lens and the back side of the cornea, but primarily by the lens. They give up their carbon dioxide back into the aqueous humor. This is similar to utilization of glucose in the aqueous humor by the lens and its production of lactic acid. You may be interested to know that the cornea, except for the most posterior surface, does not get its oxygen from the aqueous humor. Rather, it gets its oxygen from the air. The latter diffuses in through the thin membranes mentioned previously and gives up its carbon dioxide back into the air. It does utilize the glucose from the aqueous humor for metabolic purposes, however.

The iris is responsible for the coloration of the eye. Directly behind it is the posterior chamber and the aqueous humor is secreted from structures in this general area, from the sides and below the iris. Then it finds its way under the iris, out into the anterior chamber and then, of course, is drained by the canal of Schlemm. Here is an illustration

of the antero-nasal portion of a horizontal section, a magnification of the cornea, lens, iris, the posterior and anterior chambers, and the canal by which the aqueous humor is drained. You are aware what happens when the canal gets "plugged up" or there is difficulty in drainage. Glaucoma can result and there is an increase in the tension placed upon the lens. Posterior to the iris is the lens. The lens is laid down in a series of layers, a very complicated structure. Behind the lens is the vitreous body which is filled with a humor, more of a gelatinous nature than is the fluid in the anterior-posterior chambers. The vitreous humor is virtually impossible to replace if it is disrupted in the eye. It cannot be resynthesized to replace any loss. It is a very challenging problem for researchers and investigators.

The retina, as I alluded to, stops near the anterior part of the eye and the place where the retina stops is called the ora serrata ("little border"). The retina is continuous posterior except, of course, at the optic disc where the optic nerve leaves the eye. One of the important parts of the retina is the fovea centralis - a small depressed area in the center of the macula lutea ("yellow spot"). The macula is about one square millimeter in size and contains mainly the cones which are utilized for daylight, color, and very sharp vision.

We should also mention the ocular musculature. Within the eye there are two kinds of intraocular musculature. One controls the state of focus of the eye and this is handled by the ciliary muscles. Essentially what we mean by controlling the state of focus is that it allows the lens to flatten out. That is, tension is placed on suspensory ligaments or zonular fibers to flatten the lens. With relaxation of these fibers the lens becomes more rounded or spherical. In this manner we accommodate and bring objects to sharp focus. The ciliary muscles are responsible for this and that is their only responsibility. The second type of intraocular muscles are in the iris and they control the size of the aperature. As you know, when you move into a lighted area or sunlight there is a contraction of certain iris muscles with a concomitant decrease in pupil size. Conversely, coming into a darkened area the pupil gets larger allowing more light to enter the eye. The latter also is controlled by the musculature of the iris. These iris muscles are controlled by the autonomic nervous system. We have two types of muscles, one controlled by the sympathetic nervous system and the other controlled by the parasympathetic nervous system. You have experienced this yourself in an ophthalmologist's office when he puts cycloplegic (drug) drops into your eye. This causes a temporary paralysis of the parasympathetic control of the eye. Thus, the

pupil is dilated and the result is over-control from the sympathetic system. This is an excellent way, of course, to refract an eye. The third type of muscular system is the extraocular or extrinsic muscular system which was discussed earlier. These are the oblique and recti muscles which control the direction the eyes may be moved.

It is not necessary to go into detail about the retina. The retina is made up of cones and rods. The rods are rather thin in structure and are utilized primarily for twilight vision, sometimes called scotopic vision. As I mentioned, the cones are very numerous in the foveal and macular regions of the retina. These are principally used for color and daylight vision, also called photopic vision. The retina is extremely sensitive to light. A very few quanta of light can be perceived, as you know.

At this time, I should like to discuss some of the physical principles of optics. It is appropriate to talk first about the basic physics and physical principles of optics as related to a non-living system, in other words, a plain lens, i.e., a camera lens. We will relate this back to the human eye and make some comparisons with the static lens. With this kind of analogy, you will be able to make a clearer comparison and have a better comprehension.

Concerning general information on physical principles, you need to know something about the refraction of light. Light can travel through a vacuum at something like 300,000 kilometers/second and, for our purposes, we will use the same figure for light traveling through air, 300,000 kilometers/second. Obviously its speed will be decreased when it strikes a solid or liquid. There is a term called the "refractive index" which is very helpful in referring to the speed of light through media such as a solid or a liquid or a dense gas. The refractive index is the speed of light through the air (300,000 kilometers/second) divided by the speed of light through the substance. As an example, let us say light strikes a piece of glass. The speed at which light rays travel through the glass will depend upon the convexity of glass. If this speed is 200,000 kilometers/second, we come out with a refractive index of 1.5. These figures are important when considering the eye. Think back a moment ago, concerning the anatomy. One must remember there is a convex surface on the anterior surface of the eye (cornea and its five layers) while the posterior aspect of the cornea is concave. Next, posteriorly, there is the aqueous humor, then another convex surface (front of lens), then the backside (posterior) convex surface of the lens, and finally, the vitreous humor and thence

to the retina. The light must pass through many structures, material, and media to get to the retina. This has been worked out with reference to the speed of light through each of these parts of the eye. I will not give you the refractive indices for each part, however, as we further discuss the eye. I will give you the total refractive power of the human eye at rest and accommodated for distant vision. Perhaps this will enable you to understand the "refractive index" concept a little better.

What does this term refraction mean? It is simply the bending of light rays at some kind of angulated interface -- lens, substance, or whatever it might be. As an example, suppose you have parallel light rays traveling from a distant source toward a convex lens. This convex lens will cause the light rays to bend and come to a focal point at some distant point behind the lens. The distance from the center of the lens to the focal point is called the focal length for that particular convex lens. It is the same for a cylindrical lens. If there is a cylindrical lens and light rays entered from the proper direction, the same thing would occur. There would be a focal point but rather than coming to a point it would come to a focal line. Essentially the same thing will happen with the cylindrical lens as with a spherical lens. A concave lens, on the other hand, will cause the light rays to diverge. Light rays entering a concave lens will diverge and will not come to a focal point at a particular distance behind the lens. An exception are the light rays passing through the lens center which is not refracted. This is true whether light passes through the true center of a concave or a convex lens. Technically, from a physical point of view, at some ad infinitum distance behind a concave lens the light rays do come to a point of focus.

We should say something about the formation of an image by a convex lens. Consider what happens with a camera lens. Suppose there is an individual standing with light rays reflected from him through a lens, much as if you had taken a picture of him. What happens to him on the film? You find that the person is upside down and inverted. This is what is seen on the film and this is also what is seen on the retina. This concept is well known. We have simply learned to place things upright and in their proper perspective. Some of you may have read about the psychological experiments in which glasses were placed on student volunteers and the glasses caused everything to be upside down and inverted. They kept these on for two weeks - balls bounced down and up rather than up and down. It was a very emotional ordeal for the students for the first three or four days. Then they began to adapt and adjust and by the end of two weeks they were quite well adapted. When they took

the glasses off they had to go back through the relearning process again. Let us say a word or two about the refractive power of a lens. The more the lens bends the light rays the greater will be the refractive power. This is measured in diopters. The refractive power of a lens is equal to one meter divided by the focal length of the lens. If we have a convex lens and light comes to a focal point 0.5 meters behind the lens, the refractive power of that lens would be one divided by one-half or two diopters.

With reference to optics of the eye, the eye is optically equivalent to a camera (lens system, variable aperature system, and film) with the retina corresponding to the film. Previously, I discussed refractive index. Perhaps you would be interested to know that if one considers the human eye as a "reduced eye" or single lens system and we algebraically add all the refractive indices from anterior cornea to vitreous humor, we obtain a total refractive power of 59 diopters when the lens is accommodated for distant vision. The major share of the refractive power, about 60 per cent, is contributed by the anterior cornea whereas the lens is responsible for perhaps 39 per cent. The expression "accommodation" has been used here and really has reference to refractive power of the lens, that is, the ability of the lens to change shape and assist in maintaining a sharp or critical focus. The lens is quite malleable in young children and as a result the normal child has maximum accommodative capability which gives him a range of approximately 17 diopters (from 25 to 42). As one gets older lens elasticity decreases thus reducing accommodation. By the time we reach the half century mark progressive denaturation of the lens proteins has resulted to the point where the lens has very little flexibility. Its elasticity is reduced and accommodation is decreased to perhaps only two diopters. As a result, to see clearly at a distance and nearby, bifocal lenses will be required. The term to describe this loss of accommodation with age is presbyopia. I should also comment upon another lens abnormality called aberration, of which there may be two types. These are spherical aberration and chromatic aberration. You may be aware that the lens of the human eye is not nearly so regularly formed as an artificial lens. Imperfection exists in shape, the light rays entering the eye and passing through planes of imperfection in the lens may not come to a point of focus. As a result visual acuity is decreased. This is an example of spherical aberration. The term chromatic, as you know, has reference to color. Thus, in chromatic aberration the refractive power of the lens is different for different colors and the latter will focus at variable depths behind the lens.

We should discuss the basic principles concerning errors of refraction. This can be done by simply stating and explaining each refractive error. Emmetropia, of course, is normal vision, the implication being that entering light rays have a focal point on the macula and fovea. If the light rays come to a point of focus behind the retina the condition must be corrected with artificial convex lenses. That is, the focal point must be shortened in order to obtain a clear retinal image. This condition, which can be due to a short antero-posterior axis of the eyeball proper, is known as hypermetropia (hyperopia). A second defect may be due to elongation of the eyeball and the entering light rays focus in front of the retina. This condition is myopia and can be corrected with artificial lenses that will diverge the light rays to a retinal point of focus. Hence, concave lenses correct myopia. The last defect is astigmatism. Simply stated, it really is a combination of hypermetropia and myopia. Further, it may occur at any specific plane relative to entering light. The defect can be on the anterior surface of the cornea, on the posterior surface of the cornea, or within the lens. Normally astigmatism is due to an anterior corneal defect and at some particular location the anterior corneal surface may assume an oblong shape. In essence this is due to a slight depression and/or ridge. Light waves striking such surfaces are bent to such a degree that some focus in front of, and some focus behind, the retina. There is an aberrant state. The condition is analogous to the superimposition of a spherical lens on a cylindrical lens. The ophthalmologist or optometrist usually can correct this abnormality by use of proper scientific equipment to determine the axes or meridians of astigmatism.

The final concept concerning physical principles of optics is visual acuity. The term may be formally described as the ability to recognize the separateness of two parallel lines. In a more informal description, it has to do with our ability to recognize and resolve form, shape, and outline. In order to comprehend visual acuity you must have an understanding of what is meant by the term visual angle. Previously we inferred that light rays must cross within the eye if the true image on the retina is inverted and reversed. The angle formed between the point where these rays meet and the retina is called the visual angle. The distance from this point to the retina is approximately 17 millimeters. The emmetropic eye can resolve two points when the visual angle is one minute or greater. Actually, the angle has a value of 1.321 minutes. Obviously as an object is moved away from the front of the eye the visual angle becomes smaller. If we are to continue to acutely perceive an object it must be proportionately increased in

size. Visual acuity is the reciprocal of the visual angle. Consequently, if the visual angle is 1.321 minutes the visual acuity would be one divided by 1.321 or 0.756. Such numbers are really not used very often.

I know some of you think quite harshly of the Snellen test. However, it was very scientifically designed. The subject sits at a distance of six meters from the chart (20 feet). The size of the letters were very carefully graded. The width and heighth of any single figure is five times any of its component parts. As an example, if one takes the letter E, it can be divided into five equal parts. These parts are such that each line and each space (from left to right and top to bottom) is one-fifth of the total sum. Every letter is designed in this way. The purpose of this, of course, is to keep going down in size of graded letters or figures until such time as the smallest figure or letter can be recognized, meaning that one can still recognize the separateness of two parallel lines, in other words, the line and the space. Essentially, this is visual acuity. It is also very easy to determine the visual angle. There are other variables involved. The distance to the chart is known, the size of the letters is known, and the distance of the lens to the retina is known. The only thing not known is the heighth of the letter on the macula. The latter is only about one millimeter in size so it will be within the micron level obviously. However, this can be determined very nicely by knowing some of the values. More importantly, the visual angle can be determined and from the visual angle the visual acuity can be determined. The test was designed so that at a distance of 60 meters or 200 feet the visual angle would be one minute or greater if the designated letters are recognized at that distance. Of course, there are intermediate distances, 36 meters (120 feet), 14 meters, and down to 6 meters or even 5 meters which is about 16 feet. Each has been constructed such that with normal vision the angle is approximately one minute. There is a formula: $V=d/D$. V is the visual angle, d is the distance to the chart (this distance is always constant at 6 meters or 20 feet), and D is the distance at which the letter <u>should</u> be read. If an individual is sitting at 20 feet and can read the appropriate sized letter, the formula would be $V=20/20$ or 1 (minute). This commonly is known as 20/20 vision. If the angle is more acute, one may have "20/15" vision. That is, the eye sees at 20 feet that which the normal eye reads at 15 feet. On occasion there is an individual who has "20/10" vision. There are ways in which one can actually work at retaining sharp vision. As you know, ophthalmologists are surgeons, and with certain operations

they wear visual aids in order to magnify tremendously parts of the patients' eye. Looking through a very highly magnified piece of optical material can cause deviation of the eye, actually a kind of strabismus. In order to prevent this, many ophthalmologists perform eye exercises perhaps one-half hour every day. As an example, one may bring the tip of his forefinger toward the nose and follow it closely with the eyes right to the tip. This may be done several times a day to strengthen the extrinsic eye muscles.

Finally, I would like to show you the neural connections between the retina and the occipital lobe of the forebrain. Here is a schematic of the visual pathways (Schick Chart NS 15). If we were to remove the top of the skull, we would see the sinuses and air cells that we were talking about earlier. Also, note the extrinsic muscles that we discussed. You will notice that there are two colors representing the neural connections from the eye to the visual cortex. Those in <u>blue</u> go to the <u>left</u> side of the brain, those in <u>red</u> to the <u>right</u> side of the brain. Note that the optic fibers which arise from the temporal aspect of either eye course back and stay on the <u>same</u> side of the brain. The nasal fibers cross at the optic chiasma and course to the opposite side of the brain. This "cross-over" concept also is seen with neural tracts that descend from the brain into the spinal cord. For example, if a person suffers a stroke to the <u>left</u> side of the body the <u>right</u> side of the brain usually will be involved. We have the same concept applicable to the optic tracts. Knowledge of this is of tremendous importance to the neurologist and neurosurgeon when visual defects occur due to tumors or injuries. Although the concept is simple, we are dealing with hundreds of thousands of fibers in each optic nerve. Determining which fiber groups have been damaged requires great training in the fields of neuroanatomy and neurophysiology.

DISEASES OF THE EYE AS RELATED TO LOW VISION

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Introduction

This afternoon we will discuss some of the diseases of the eye as related to low vision. I know you would be most interested in diseases that affect vision in children and cause them to become visually handicapped. It is quite difficult to pick out such diseases. Remember, we are talking about diseases only and not traumatic accidents, although trauma is a primary cause of visual problems in children. When we talk about diseases *per se* there are not a great number one can discuss with sole reference to children. I will talk about *all* of the diseases of the eyes common to at least three of the five age groups, which are, incidentally, the older adult, the younger adult, the teenager, the pre-teenager, and the pre-schooler. We will discuss whether it is a developmental disease, an accommodative problem, or a traumatic injury. We will cover many diseases but will not spend too much time on any one unless it is specific to children.

First, there are a few general concepts that I would like to review with you. The first has to do with any sort of a visual handicap that the child may have. It behooves not only the parents and the physician, but certainly the teacher, to teach and handle this person as if he were a *normal* child. There are emotional problems the teacher must cope with; not only the child's problems but also the emotional problems as they may affect the teacher. As an example, suppose there is a youngster who has had a traumatic accident to the eye and has lost vision in one eye completely and has lost it partially in the other eye. This is a completely different problem, as I am sure you will admit, from a youngster who has had the same degree of visual handicap from birth. In the former situation when the trauma is over and the youngster has returned to school, what does he face? One, he has lost binocularity; two, he has lost depth perception; three, he has lost field of vision. These three things will present psychological problems. Clumsiness obviously will develop. In the latter situation the child has adapted to the low field

of vision, the loss of binocularity, less perception, and so on. A good deal of evaluation has to be done, as I am sure you will agree.

Some time ago it was thought, and all of you are aware of this, that the eyes should be given a rest occasionally. This is not so at all. One cannot damage the eyes by any kind of normal use. When one reaches the point that he cannot focus or concentrate any more simple fatigue, sometimes called eye strain, has occured. However, all we are talking about is fatigue of the muscles of the eye. They simply cannot properly accommodate any further and, hence, must rest for awhile. There is no damage done to the eyes through normal use.

As most of you know, we have a shortage of physicians; it is acute in many areas. I believe it is reasonably acute in ophthalmology. However, I am happy to report that the ophthalmologist who instructs in The Eye course says that "all children should have a complete ophthalmological examination by the time they are age 18 months. This should be routine." In other words, every child that is born in this country should have an ophthalmological exam. You can imagine what this would entail! A complete exam of this type takes a great deal of time. Time is something physicians do not seem to have a lot of because many are overworked. But, think of the ramifications of this sort of program when it is realized that five to six per cent of the newborn have a visual handicap. That is, five to six of every 100 children have some sort of visual defect! If a complete ophthalmological exam could be given each child, many of those with early reversible defects might be cured. It would certainly reduce the number of visually defective children and adults.

Some of the diseases that we will discuss result in partial vision to the five groups I mentioned earlier. Frequently, the loss of vision results from two or more diseases or eye conditions. This is particularly true of the partially seeing.

(Note: Again, the lecture has been presented in outline form to facilitate its use for future reference.)

I. <u>Strabismus</u>
   1. Ocular muscle imbalance.
      Note: might review extrinsic muscles actions here.
   2. One, or more, muscles imbalanced.
   3. 5-6% of all children have some eye muscle imbalance.
   4. Forms of strabismus:

a. Esotropia (ET)
    1. Most common form of strabismus.
    2. Eye turns in (cross-eye).
b. Exotropia (XT)
    1. Next most common form.
    2. Eye turns out (wall-eye).
c. Hypertropia
    1. Least common form.
    2. Eye turns up; the other is relatively down but can be in normal position.

5. Causes can be placed in three categories:
    a. Developmental
        1. Born with muscle imbalance (incl. birth injuries).
    b. Accommodative
        1. Difficulty in focusing; over-accommodates; eyes turn in.
            a. Can cure early with glasses.
    c. Paralytic
        1. Trauma; can include birth trauma (i.e., brain injury).
    d. Can have combinations of all three types.
    e. May need surgery in any of the three categories:
        1. Usually between 1-2 years of age or later.
        2. Recession (weakening a strong muscle) preferred over resection (strengthening a weak muscle) - reason: both eyes work as a unit - could surgically weaken both eyes (preferred method on East coast of U.S.).
        3. West coast preference - recession of one muscle and resection of opposite muscle.

6. Factors of concern in strabismus:
    a. Visual acuity
        1. Most important factor and that which needs the greatest care (family, at school).
        2. If amblyopia - recommended treatment is patching (patch good eye, force child to use poor eye).
            a. This can actually decrease visual acuity and become an emotional problem; parents need to work acutely with child for first few days so he won't tear patch off.
            b. Do not patch for more than 2 weeks - can get amblyopia in good eye.
            c. Idea may be to get alternating esotropia - visual acuity usually will be ok in both eyes eventually.
                1. If physician feels he can achieve this eventually, he may alternate patching for up to 8-9 years possibly.

b. Cosmetic appearance
   1. A distant second in importance; in later years, say age 4 or older, then it can be more important.
   2. Anything above 15° esotropia (ET) is cosmetic.

c. Stereopsis (depth perception)
   1. A distant third in importance.
   2. Lots of time wasted on treatment to get this - not that important unless child has had it and then lost it. If the brain has adjusted early, he never had it. Treat the strabismus and perhaps he will get it!

II. Eyelid diseases
   1. Blepharitis
      a. Granulated eyelid; inflammation of eyelid.
      b. Very common; various degrees of seriousness.
      c. Analagous to dandruff.
      d. More common in women and children (children don't wash often enough; women use too much "make-up" on face!).
      e. Long hair could be a cause as blepharitis is on the increase.
      f. Treatment - antibiotics, steroids.
   2. Ptosis
      a. Droopy lid; usually developmental disorder.
      b. Effect usually cosmetic (can be psychological).
   3. Tumors
      a. Usually rare.
   4. Sty and Chalazion
      a. Inflammatory, usually infectious.
      b. May cause lid to close.
      c. Could be due to allergic reaction or trauma - in isolated conditions it can be serious and lead to other inflammatory changes.
   5. Conjunctivitis
      a. Generally inflammatory, usually infectious.
      b. Keep out of school for a few days.
      c. Use antibiotics.

III. Corneal diseases
   1. Corneal dystrophy
      a. Cause may be developmental or degenerative - unknown.
      b. Transplant may be indicated.
   2. Gonoccocal corneal infection
      a. Need to recognize early before individual gets atrophy of other visual parts and pathways, even into brain visual pathways.
      b. May heal of its own accord but can leave dense central corneal scar; with resultant severe visual loss (prevents light from entering eye).

c. Reason for $AgNO_3$ use in infant eyes (state law in many states).
1. Note: could induce own scarring!!

3. Dendritic keratitis
a. Common result of viral infection (such as Herpes simplex); inflammatory response.
b. Treatment - antibiotics.

4. Keratoconus
a. A degenerative disease in which the cornea "bulges out".
b. Can start in early teens.
c. Best treatment - contact lenses early; corneal transplant later (results are extremely successful).

5. Hythema of cornea
a. Opaque cornea - problem probably is behind cornea.
b. Due to a traumatic incident usually.

IV. Anterior chamber diseases
1. Hythema
a. Blood in anterior chamber.
b. Usually very serious; probably due to trauma.
c. Requires patching of both eyes; bed rest.
d. Can fill entire eye ("8-ball" eye).
e. Can lead to cataract, glaucoma, loss of eye.

2. Glaucoma
a. Can be a developmental, degenerative, or traumatic response.
b. Usually less a condition in children than adult.
1. Comes on with age due to tissue and/or functional changes - causes not completely understood.

V. Iris diseases
1. Aniridia
a. Developmental condition - born without iris.
1. Usually have associated defects.
b. Rare.

2. Albinism
a. In this case, thin iris (lets too much light in).
b. More frequently due to lack of pigment layer at retinal-choroid juncture.

3. Iritis
a. Inflammation (allergic response usually); infection.
b. Reaction of body to protect itself.
c. Can lead to other inflammatory changes.

4. Iris atrophy
a. Gradual increase of black pigmentation in iris; can result in visual loss.

5. Melanomas
   a. Rare; treat by surgery for that part of iris; not entire eye as formerly.

VI. Lens diseases
   1. Congenital cataracts
      a. Possible to diagnose early by occipital lobe stimulation to check motor effects and perception.
      b. Can occur as epidemics (related to German measles) - an inflammatory response in mother in first trimester and congenital to fetus.
         1. May cause heart, brain, other congenital defects.
      c. Early eye exam should note presence.
      d. Operate early (within 18 mos. age).
      e. Developmental or secondary to inflammation.

VII. Retinal diseases
   1. Rarely absent or totally diseased (coloboma - born without).
   2. Retinoblastoma
      a. Tumor
      b. Can occur in children; infancy to 3-5 yrs; common.
      c. Can be bilateral.
      d. Primary treatment - enucleation; treat second eye by photocoagulation, chemicals, laser.
      e. May see esotropia, strabismus initially - in which case, need to treat early to save part of vision in that eye.
      f. Genetic - 75 to 90% possibility of offspring having the disease.
      g. Called melanoma sarcosis in adult:
         1. More difficult to diagnose.
   3. Vascular disorders
      a. Acute engorgement in veins and/or arteries in retina.
      b. Can treat with blood-thinning drugs.
   4. Hypertensive retinopathy
      a. Graded 1 to 4 (worst).
      b. Can treat many satisfactorily with drugs.
   5. Retinal detachment
      a. Choroidal or retinal rupture due to trauma.
      b. Basically, however, is a degenerative disease.
      c. Where occurs with trauma can also see:
         1. Macular changes (arc welding, sun eclipse, burns).
         2. Hythema
         3. Commatio retini (direct blow to eye - no hope).
   6. Histoplasmosis chorioretinitis
      a. Seen in children, young adults.
      b. Treat immediately with steroids.

7. Retinitis
   a. Inflammatory - usually always associated with choroiditis.
8. Retrolental fibroplasia
   a. Too much oxygen to premature infant or to child.
   b. On the increase - would not previously have saved child and must give O_2 to save life.
   c. Largest singular factor of visual impairment in late 1940's and early 1950's; finally diagnosed and decreased to cure. Children must be treated in normal way!!

VIII. Optic nerve diseases
1. Coloboma (rare) - born without II nerve.
2. Optic neuritis
   a. Often associated with multiple sclerosis.
   b. Inflammatory response to infection; allergy.
3. Evulsion, rupture
   a. Traumatic response - snap II nerve in two pieces or more.
4. Tumors are rare to II nerve.

CLASSIFICATION, DESCRIPTION, AND BASIC DESIGN AND PRINCIPLES OF LOW VISION AIDS

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I would like to present a variety of low vision aids, discussing classification as they are exhibited. I want each of you to examine some of the aids - especially the microscopes - looking at them as a patient would. (It is noted that the aids discussed are being shown and demonstrated.) Hold them up next to the glasses and look at the print. You may either use our testing cards or any typewritten material and observe the focus as well as any other factors, such as the working distance necessary, the field of view, the number of letters or words seen as the succession distance, and distortions that are present out to the periphery. This will afford you a better understanding of the difficulties that a partially seeing person would have in using the aid initially. After adaptive training, it is possible that the aid can be used so that a person can function as efficiently as a person functions with normal vision. This depends upon the type of aid prescribed.

The general function of a low vision aid is to present a larger retinal stimulus in the back of the eye. Since there is a larger image, this will stimulate more nerve receptors in the back of the eye -- especially in certain types of pathology. As more areas of the retina are stimulated, the visual acuity will be increased.

The first classification is the aid for distance vision, and the first type is the telescopic aid. There are several kinds, depending upon whether they are hand-held or spectacle lenses. Some of these aid types are commercially made, as is the monocular telescope, and are available in any sports store. They are excellent when initially adapting to a telescope. Of course, these can be used only for a few minutes at a time. Should a person have the sort of occupation or avocation in which he needs a little better acuity of distance, this type of lens could be used. Any pair of binoculars gives one a very limited field of view. This is poor if a patient

must wear an aid all the time. The type of monocular just worn a few minutes is not too bad since the wearer has very good control.

The other types of telescopes are to be placed in spectacle lenses. They are constructed on basically the same theory except that they are smaller, more compact, and cosmetically better suited. This full-diameter telescope is, in some instances, cosmetically rejected because of the bulged lenses. However, this gives a better field of view than some other telescopes that are available. Another type of telescope with some cosmetic appeal is optically based on the same principle, but is more compact. The disadvantage is that the field of view is much less. However, the power remains the same.

Here is a telescope designed to be placed at the top part of the lens and the spectacle. This is not to be used all the time. Many people have the opinion that a telescope is to be used for distance, so it is supposed to be used constantly. This is false; this telescope is designed to be used only in a stationary position when one needs a little sharper acuity at distance. It is angled up somewhat. If one were looking straight ahead, he would be looking through the special lens. When a child has to read something on the blackboard, he would need a little sharper acuity at distance. He would simply move his head down and, holding the lens still, he would be able to see the larger image. This lens is very good should the patient demonstrate this kind of need. If he sees a real advantage in it, of course he will use it much more.

The child adjusting to a new aid should be introduced to different people so that he will not feel rejected by wearing the aid initially. Should he think he is very special, he may have a better time wearing it, contrasted to the child who thinks he is different. The cosmetic factors are very great. We would prefer to prescribe a low vision aid that the child will wear, rather than the theoretically ideal prescription which the patient never uses at all.

If the patient needs a slight amount of magnification, just enough in order to resolve some writing on the blackboard or at some job, there is a type which is very good. There is a slight button on top. Of course, one should remember that the smaller lenses provide a reduced field of vision. The patient who initially got this type would possibly first require a bit of adaptive training in the telescopes that give the larger field of vision. The

telescopes are constructed in a plastic carrier with glass lenses. The hand magnifier with an aspheric design has to be a plastic type of construction. The advantages, disadvantages, and the limitations will be more thoroughly discussed later.

Distance also includes spectacle lenses and contact lenses. Normally one thinks only of bulged lenses or lenses with very different cosmetic appearances, but not of a regular spectacle lens as a low vision aid. In fact, in the examination, this is the first type of correction tried to see whether it increases the acuity or is simply correcting the refracted error. Many low vision children or young adults can be helped tremendously with the correct prescription. It may increase a visual acuity measure from 20/400 to 20/200. If the patient has not worn lenses before, we would first like to see what the regular normal routine correction of a spectacle lens will do. Many times this accomplishes more than a practitioner will realize.

Pinhole contact lenses are fitted on exactly the same principle as ordinary contacts, except for the lenses themselves. The entire areas is blacked out and several holes (or a fairly large one) are drilled into it. In some cases, the iris of the eye is very large or there is a coloboma present -- the iris is missing a segment of it instead of normally encompassing this area. This allows stray light to penetrate and lets the aberrations through and the peripheral part of the cornea takes over so that there is reduced vision. The pinhole will actually act as an artificial iris and an artificial pupil.

Another use of the contact lens is for correcting very high astigmatism, which is corrected to much better degree with contact lenses. With such cases as keratoconus, in which the cornea is protruding and distorted to an aspheric circle, the contact is found to be helpful. The contact lens acts as an artificial cornea which increases the acuity by giving a more symmetrical appearance to the cornea.

The second general classification is for intermediate vision. The aids available in this area are limited because of the optics involved. The low vision aid for intermediate vision is technically called a telemicroscope. This is essentially a telescopic correction with a reading cap placed upon it. If the patient wants to see an object 16 inches, 12 inches or whatever is best suited for the patient and his individual case, he places the reading cap

on the telescopic lens. There is a magnified image at the intermediate distance and, of course, it has to be used at that distance. The laboratory can design an aid which will be only for intermediate distance. The cap is placed in the center of the aid. The aid could be a regular telescope with which the patient carries a reading cap, placing it on the telescope when he wishes to view work at the intermediate distance.

There are many types of correction and, theoretically, low vision aids for near vision. This is the most widely corrected area in dealing in low vision because of the demands so far as reading and near vision requirements are concerned. The most success with low vision aids is apparent in this area.

The most simple type of near aid is the hand magnifier. The hand magnifier is usually given as an adaptive training type of low vision aid in which focus is fixed. It can be placed at any distance and the patient will have the same amount of magnification. More problems exist with higher degrees of magnification. Another type of magnifier in this group is not in a fixed position. It has to be held and manipulated. Good head-hand-eye coordination is necessary in order to use this effectively. Some people need the magnification and yet do not wish to carry a large aid like the hand magnifier, so an aid such as this is quite commonly used. It is very rarely given initially because of the many problems that are involved. The field of view is very limited. It has the advantage of being lightweight, small, and compact.

The high plus bifocal or high plus add, as it is usually called in the profession, is another type of aid in this classification. "Add" comes from the fact that in a bifocal you have a higher additional power than in a distance. This type of aid is similar to a regular bifocal, but instead of giving the power necessary for a routine patient, which is the region between 14 and 16 inches from the eye, we prescribe a much higher power. The patient has to hold it closer. In lower powers, the bifocals look similar to the regular type of ordinary bifocals. Sometimes instead of a bifocal form there is a single lens, but with half an eye; in other words if a patient wears it, he has a distance vision and can look down through the lens for near vision. Instead of the bifocal, which is fused with the top part of the lens, there is a carrier type of lens into which this has been cemented, making a single vision lens. Many times the regular bifocals are blended according to the ability of the laboratory in constructing the amount of power desired.

The third area is that of microscopes. Many times the question is asked, "What is the difference between a high bifocal and a microscope?" Essentially the difference is that a microscope is usually a much higher power. The usual reading distance in a microscope is between 1 and 5 inches. The highest power bifocal is usually held 4 inches from the viewed object. In a bifocal, the power notation is a little different. The Feinbloom type is a full diameter microscope. It is a doublet spectacle in powers -- 2X, 4X, 6X...20X. There is a type of bifocal in which you may have a small diameter telescope at the top and the microscopic power on the bottom. Another type of microscopic lens has a short working distance. Cosmetically this type of construction would be rejected.

We have reviewed some of the low vision aid types which may be prescribed to meet various individual needs. They have been classified according to the telescopic lenses for distance, intermediate telemicroscope lenses for general use or activities, and microscopic lenses for near vision use.

Basic Design and Principle Behind Low Vision Aids

The design and the principle behind low vision aids is rather technical. We should at least mention it just to give you a brief understanding of the current ways in which low vision aids are constructed.

The telescope is designed with a plus lens and a very strong minus lens. When light strikes the front part, it will refract and then diverge in a tremendous amount to project a respectively large image. The light rays have to strike parallel. In order to have the focus of the object clear, a target must be observed beyond about ten feet. Close use would allow a blurred image to be seen.

The second general classification of telemicroscopes is essentially a telescope that adds a plus lens in front. The focal distance of this lens is sixteen inches. The light is diverted and becomes parallel. It is necessary to have parallel light rays. The one advantage of telemicroscopes is the fact that these lenses can be used at a close distance, relative to ten feet.

Microscopes are of several different designs as briefly mentioned, depending on the manufacturer. The American Optical Aspheric Lens has a single lens design. Because this is plastic, it eliminates many aberrations. A plastic lens as it is manufactured is not a complete sphere. Any type of glass, once it is ground, is a complete spherical circle. As plastic is formed, it has been flattened in the peripheral part. This flatness creates an aspheric circle. It eliminates many of the aberrations that are present. One company may have a single lens while others produce a lens with two lenses

involved. They both eliminate many aberrations that are present in a high power lens, and they both do a quite adequate job with different designs. Here is a set that is constructed to have two lenses combined. You can see it is much better than high powers. The two lenses are together with a very faint air space between. A lens has been produced with three lenses that are cemented together with no air space. Despite technical aberrations that are eliminated in different lenses, each one of the lenses still makes a certain amount of aberrations. However, if you use any one of them in high power, it will have a very good image.

The principle behind low vision aids and the principle behind increasing acuity of low vision patients is magnification. When we speak of magnification, we speak in terms of increasing the angular size of the image. Because of the distance or the lenses you are looking through, the line that connects the top of the image (and this would be the image that is formed in the back of the eye of the particular object that you are looking at) forms the angle. By magnification, we have tried to increase this angle so that one will get a larger image in the back of the eye. There are three different methods of increasing this angle, and it does not necessarily have to involve a low vision aid.

The first type of magnification is the relative distance magnification. It does not deal with a low vision aid at all, but only with relative distance. We simply move an object closer and the eye needs no magnification. If we look at a certain object 20 inches away, technically at that distance the reflected object or the height of the object will be .06 milimeters. If we move the same object to this point, it will be a little bit closer to .6 milimeters. Since we have effectively increased the image ten times, we can say that 10X magnification has been produced. We have effectively increased the size ten times. This is very important. It is not only the way that people can see without low vision aids but is also one of the main principles which govern how low vision aids work. We simply move the material much closer, and this produces a larger angle and, of course, a larger image.

This is the principle of accommodation of the eye. The changing shapes of the crystalline lens enables one to see at various distances. Of course the younger one is, the closer he can see for a longer period of time. Due to the aging process, usually when one passes forty, he starts having problems seeing at close range. The accommodation in the eye has decreased to a point at which

help is needed to see. When a child is very young, this power of accommodation is great. As the aging process continues, even from 5 to 10 years old, the accommodation decreases at a very steady rate. Possibly some people could see material at 2 inches, but reading it for a few minutes causes the power of accommodation to decrease and the image to blur. Material can be brought close, possibly 4 to 6 inches. Many times we find that children initially may not need low vision aid because they have a tremendous amount of magnification simply by holding the material or object quite close. One starts to accommodate from about arm's length. If a person had no accommodative ability, he would see a clear object until it was at about arm's length. Then, it would start to become blurred. A normal person, for example a teenager with normal accommodative ability, automatically changes focus for the adjusted distances. He may not be able to see any closer than 4 or 5 inches without the object becoming blurred. A child uses a great deal of this accommodative ability to read at close distances. When the accommodative ability is lost, the magnification is also lost. This may cause a need for change in print size in later years or an aid necessary to see at close distances. He may have difficulty with the object at close distances because it becomes increasingly blurred. If a low vision child starts to work at close range, he will retain his accommodative ability longer because he is using it continually.

Another type of classification is relative size. By relative size magnification, we mean keeping the target or object at the same distance and making the object larger. This means that the angle at the back of the eye changes. If an object is four times as large effectively, there is four times the magnification or a four times larger image in the back of the eye. This is the principle behind larger print books.

The third type of magnification is done with lenses. It is the angular magnification that comes essentially from the lenses, keeping the object at the same distance and the same size. Some type of low vision aid is placed in front of the eye. The light ray will be refracted through the aid to create a greater angle and there would appear to be a larger image. If a patient has a low vision aid, he gets magnification from the lens and also the relative distance magnification. If the microscope were used, it would have to be held quite close. This gives one relative distance magnification and angular magnification from the lens. As the child grows older,

his accommodative powers gradually decrease, but the print becomes smaller and the demands greater. This may lead to difficulties with reading. He will probably benefit greatly at this point from some type of low vision aid. By necessity, this low vision aid takes the place of some of the accommodated ability that is lost. The focal point of this lens must be held close to the work, so that he gains possibly more magnification than he had. Instead of reading large print, he can possibly read standard size print.

THE VISUAL EXAMINATION, SELECTION OF LOW VISION AIDS, AND ADAPTIVE TRAINING

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Low Vision Examination

I would like to go through the technical steps of a low vision examination. The first consideration is the general responsibility of the doctor to measure the vision that is present at the time, to find out from the patient what level of vision he would like to have, then through the use of aids and with technical knowledge, try to give the patient that level of acuity. There are approximately four different steps in an examination: the case history, the examination techniques of a technical aspect, the evaluation of the findings, and the final prescription. The recording of data, especially in relation to children, is of course necessary to the teacher, the psychologist, and other related professions. The follow-up is the progress analysis.

The case history is included on the examination form. This is self-explanatory. Not every question on this form is related to children or many do not apply to children. It is important to have as much information as possible in the case history. For example, the doctor in diagnosis examines the cause of low vision, determines prognosis, and gathers information concerning the health history and the education of the child. The present visual status from the child and the parents is important here. Can the child walk without assistance? Is he more sensitive to bright light or dim light? Does the child read? What visual capacities does the child have now? Giving an examination in case history does not begin and end with one page. One is constantly asking the patient questions and getting opinions from the patient as to what he can and would like to do.

The procedures of the examination continue with the analysis of the present prescription and its effectiveness if the patient is wearing special lenses or if he has a low vision aid. The visual acuity is an extremely important area. From the case history of an examination, we

find at what level the patient would like to function. Measuring acuity determines what vision the patient has at the time and the level to which it may be increased with low vision aids. In taking acuities of low vision cases, reading cards are used rather than a projection type of measurement. This gives greater latitude, has larger letters, and obtains a more refined acuity as opposed to other types of techniques. This text is taken normally at 10 feet and sometimes at 5 feet, depending upon the level of vision. The cards are lettered and numbered. If the patient does not know the number or the letter, the acuity is measured with picture cards. If this child can understand the "E" Chart and the different directions, this can help to determine the level of acuity.

The Optical Kinetic Drum is another means of testing acuity, either in a child with very low vision or in very young children. This is not an extremely precise method, but it is better than just saying that the child is completely blind with no hope at all. The optical Kinetic Drum is three dimensional. There are different lines on the drum, and as it is rotated very slowly at the beginning, it is placed in front of the child so that the examiner may observe the reflex of the eye taking place. As the drum is rotating, the eye will fixate on one point, roll the eye over, and the eyes will possibly shift back and forth. We spin the drum at a faster speed until the eye no longer has these estagonial movements. In order to become more precise, a certain formula is used. From this, one can calculate what general acuity the child has. Usually this is done just to see if the child has any movements of the eyes at all.

The next procedure is to examine, for pathology, the disease of the eye. The external examination, of course, involves the external part of the eye and is usually done with the pen light. The ophthalmoscopy is done with an instrument which allows the examiner to look into the eye to examine the lens of the eye. Ophthalmometry is a method of measuring the curvature of the cornea. The instrument or the use of the reflected light measures the curvature to find if there is any gross amount of astigmatism present and to see if the curvature of the cornea is spherical or if there is an aspheric condition. Static retinoscopy is a fairly technical procedure in which we again use reflected light but, rather than from the cornea, we use reflected light from the retina. By the notation of the motion inside the eye, we can determine approximately what type of refractive error is present. Of course, this has certain limitations. If the lens, the cornea or the vitreous is clouded, there will not be a good reflection back from the retina so this method is sometimes not valid.

The actual examination for the low vision, like other examination procedures in optometry, is fairly unstructured. Many times the actual method used depends upon the individual case. In general, we start with the distance testing and move to the near testing. We try to perform a regular distance examination with regular ophthalmic lenses. Usually this procedure is done in a trial frame with hand lenses because the testing chart is closer.

The refinement of the refraction to a telescope is very important. The vision may be so poor that the patient may not be able to discriminate well enough for the doctor to get an accurate prescription for the glasses. The first procedure here is to take the tentative prescription that one has already derived and, placing a telescope in front of it, permit the patient to look at the chart from ten feet and measure the increase of vision. By alternating the lens in back of this, we refine the prescription. Many times by added magnification, one gets a little better acuity and more sensitivity. A regular pair of ophthalmic lenses may be the prescription at which we finally arrive. After the prescription has been refined, we try additional powers of telescopes for both eyes and record the increase of acuity.

Following this part of the examination, we go to the near point. We know the level of acuity with which we started and the distance prescription. Plus lenses are added. Of course the patient will have to bring the material closer. The increased acuity is recorded. The power of the ophthalmic plus lens and the microscopic lens is increased each time. This brings the material closer to the focal distance. The increased acuity is measured. The better eye is checked first, then the other eye in order to obtain data in an effort to find what increase in acuity is achieved.

With the telemicroscope, we can diverge from this procedure and go into other specialized areas. Each case has to be taken individually. The telescope is used and different reading caps are placed on it to determine how this suits the patient. Hand magnifiers and stand magnifiers may also be tried in an effort to increase acuity.

This has been a fairly rapid explanation of the examination procedure. Many of the tests are quite technical, but always done in an effort to find what level of increase in acuity can be obtained. The next procedure is possibly more important in some respects than the evaluation, the findings, and the prescription (which is most effective) for the patient.

The psychic factors of the patient must be considered. Many times children are dependent upon the sympathy that they receive in being a low vision patient. They thrive on the over-attention and, many times, will reject low

vision aids because they have a new responsibility. They may not want to go through the training necessary to read print in order to become visual rather than braille. If there is good motivation, even in children, better results will be obtained. One of the cardinal rules for prescribing low vision aids is to use minimum magnification to enable the patient to accomplish the task that he wants to accomplish. Especially with children, we try to give them the least complicated prescription for cosmetic reasons, rejection reasons, and because they can effectively perform with a less complicated prescription as contrasted to a quite complicated telescope-microscope prescription.

The next important task is the reporting. If a teacher realizes that a child has been examined but has not received this information, possibly she should ask for it. This is vitally important to the teacher and possibly to the child's progress in school. In reporting, the doctor should give: 1) The present visual acuity, the field of vision that is present, and any succession ability or inability. 2) The prognosis -- whether the doctor feels, because of the possible pathological conditions, that the vision will get worse, or if it is stabilized. 3) The prescription -- if the spectacle lenses or a low vision aid has been prescribed. If it has been prescribed, the teacher should have knowledge of the special instructions necessary for use of this low vision aid, especially distance. 4) The additional adaptive training necessary before the child becomes proficient in the use of the aid. 5) Specialized instructions, possibly special seating instructions and special lighting (dim or bright illumination).

The follow-up studies involve the progress reports, allow the patient to see how he is adapting to the aid or if there are any problems developing. It should be mentioned that the general function of the low vision aid is to enlarge the retinal stimulus and enlarge the retinal image. This is provided by the principle of magnification. The aids are classified for distance with the telescopes, intermediate with telemicroscopes, and near with various types of microscopes.

Limitations and Difficulties Affecting the Prescribing and Wearing of Low Vision Aids

There are limitations and difficulties which affect the prescribing and wearing of low vision aids. With greater magnification, there is greater power, especially for near, and with greater magnification, the working distance is less. When considering far, the working distance

is always the same, beyond ten feet. The field of view at near is defined as the number of letters which may be clearly seen through the low vision aid. Distance of the field of view is defined as the angular distance at which one has clear vision. At distance with a telescope, the field of view might be 20 or 30 degrees compared with the normal sighted with a normal field of view of 200 degrees. The depth of field which is best seen with a telemicroscope is defined as the position of a clear image such as the position of the target. The target can be moved toward and further away while the image remains clear. With the telemicroscope there might be an inch leeway, and it would have to be held within that inch in order to get a clear image. The higher the magnification, the greater the reduction in depth of field that one has optically. The difficulty is obvious; unless a child has good hand to eye, head coordination, he will be all over the place and not within that critical area of clear vision.

Spatial distortions are evident both at distance and at near. The aberrations at distance, and especially distortions, occur by the necessity of the magnification. This presents perceptual difficulty with the aid. If the head is moved, there is a certain amount of movement of material the opposite way, but as you move with a telescope, everything moves quite rapidly causing distortion of movement. It is very difficult to use a telescope for distance when walking around.

Spatial distortion is evident at near in extremely high powers of the different microscopes. There may be an enlarged word in the overall field of view. The word may appear distorted at the top, the central part may be quite clear, and the outside distorted. Only the central area is very clear and a person has to learn to decipher the letters and the peripheral part.

Cosmetic difficulties were mentioned several times. In general with children, we always like to prescribe an aid which they will wear. This is part of the evaluation examination. It is much better to give an aid (even though it is possibly of less benefit or of less complicated prescription) which will be worn rather than forcing an extremely complicated, horrid looking prescription on a child that he will not wear at all. The parents, the teacher, and the doctor combined can, over a period of time, possibly work into a better prescription for the child. This is especially true when dealing with telescopes. The newer designs of low vision aids have done quite a bit to minimize the cosmetic difficulties. Years ago, the only telescopes

that were made fit over both eyes and into spectacle frames. There has been tremendous improvement in low vision aid design, as well as in the aids themselves.

I stress the limitations and difficulties with low vision aids rather than telling only the good features about them. Unless the parents, children, teachers, and/or patients who are getting the aids know the limitations before they are prescribed, the aid may be rejected as soon as it is received. Often, there is the hope or lingering idea that this aid will enable them to do everything they desire and anything that a normally sighted person can do. Before a prescription is made, it is best that the person know how close he will have to hold the aid and that he will have difficulty initially in reading because of the reduced field of vision. He should also know that because of the power of magnification, he will have a hard time coming to the end of a sentence and going back to the beginning of another sentence. Unless he knows all the problems and is willing to accept them, he will derive little benefit from the aids. If the problems are known, through the adaptive training the patient can learn to overcome them or learn to accept the limitations in the use of the aid. Thus, the benefit will be much greater. The telescope, of course, is only for distance which is limiting. The field of view is much reduced and the motion amplified. It is only good for sitting down when one is in a fairly stationary position, looking at a stationary target.

Optically and theoretically the aids for intermediate distance are very good. Unfortunately most people observe the cosmetic appearance of a microscope during the examination and learn the fact that they will have to hold it at one certain distance, which requires patience and understanding of the aid. The magnification is not nearly as great as can be obtained with hand-stand magnifiers or with microscopes. When all these facts are known and the patient is shown the telemicroscope, he may prefer to have a less complicated hand-stand magnifier or some type of microscopic aid. If the person needs to see a certain distance for a certain occupation, that person will overcome the difficulties provided he has enough low vision to make it optically possible.

The greatest limitation for near is the working distance. Children who have poor head-hand-eye coordination have difficulty in holding material fairly steady within the exact focal distance. The field of view at near with relation to the speed of reading will decrease this, and of course will indirectly affect comprehension. A child

with a low vision aid microscope may not advance nearly as fast as we would like him to because of the limitations of the field of view and the number of words seen. Until initial adaptive training has been given, losing his place may also be a problem.

In near vision correction, the question of binocular vision is raised. When we correct somebody for up close, we correct only one eye. If an aid is prescribed which has to be held closer than 5 or 6 inches, there is so much convergence that it is much better to prescribe only for the better seeing eye. Prescribing for the better seeing eye allows the patient to bring the work right up in front of that eye. He uses one eye, though possibly both eyes have similar vision. If the use of one eye is suppressed at near, both eyes are used at far. The vision will not be lost because the eye is being stimulated at some distance.

Vision Training and the Low Vision Child

The final area deals with vision training and the low vision child. The initial training is, of course, in the use of the aid. With any low vision patient, the cardinal instruction is that one moves the reading material and not the head. If one were to hold the material stationary and move his head, he would be changing the working distance somewhat. If one holds his head straight and moves the target along, the same working distance can be effectively maintained. The amount of motion can be controlled by moving the material, but if the head moves many times, the target moves quite rapidly and the place is lost. The proper working distance must be maintained. Many times with children, this is a very difficult problem because there may be developmental deficiencies which have not allowed development of adequate head-eye-hand coordination ability to hold the material steady at the working distance. Many times, because of poor vision over a long period of time, they have not developed adequate coordination. They are handicapped in using the aids and often will be required to take a school program or special developmental coordination training in order to use the aid properly.

Another item of instruction is lighting. I failed to mention that we always test under different levels of illumination in the examination procedure. We are never certain whether a patient can see better under very bright illumination, very dim illumination or moderate illumination. Whichever type of illumination gives the best acuity with the low vision aid is determined with the patient.

Other types of training include adults who have not read for a few years because of a degeneration. Though they have read at one time, and using an aid is quite a help, they must learn to adjust to the differences. Visual training in binocular fusion is necessary if a person is worried about losing vision. In a child, if we see that the eye at distance is beginning to wander, and if the eye is turning in and turning out, fusion training may be needed as far as stabilizing the binocular vision. The many other types of optometric training that can be given depend upon the individual case.

ADMINISTRATION AND COORDINATION OF A TRAINING PROGRAM IN A LOW VISION CLINIC

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Organization of the Low Vision Service

The Low Vision Service at the Chicago Lighthouse for the Blind was organized in 1955 with a joint committee made up of five members from the Chicago Ophthalmological Society and five members from the Illinois Optometric Association. There is a consulting ophthalmologist and an examining optometrist. The patients come to the clinic upon recommendation from their doctor. Following the examination, the doctor of the patient receives the report, making the clinic an adjunctive service. The referrals may also be made by clinics, health services, private ophthalmologists and optometrists, public agencies such as the Division of Vocational Rehabilitation and the Veterans' Administration, and from other patients.

Statistical Report - 1969

In 1969, 167 patients were examined. Of these, 47% were referred by ophthalmologists and optometrists, 27% by the Division of Rehabilitation, and the remaining 26% from hospitals, clinics, and other agencies. Only one reference came from a teacher. Of the patients who were examined, 121 received aids, 26 had too limited visual acuity, 9 were progressive in nature, 5 could not adapt to the aid, and 6 patients were corrected to the highest level. Of the group who received aids, 99 were dispensed at the Lighthouse and 21 by the referring agency. One patient refused an aid.

The Low Vision Program endeavors to help the visually handicapped person to achieve maximum use of residual vision and to increase his employability. Those involved with the program work with public and private agencies in the community, including medical and paramedical services, so that the needs of the patient may be met more effectively. Service of this kind is time consuming. The average professional time required for the first examination is approximately two and a quarter hours. A

progress analysis requires approximately one and a quarter hours. No patient is rejected on the basis that fees cannot be paid. These are absorbed by the Lighthouse, Lions Clubs and other sponsoring agencies.

Speaker's Story of Low Vision Aids

My story of the use of low vision aids begins ten years ago when I was a junior at the Illinois Braille and Sight Saving School. I have congenital coloboma of the retina and iris with micropthalmia of the right eye. Without correction, I have 20/400 vision in the left eye and total blindness in the right eye. The examining optometrist prescribed a pin hole contact lens for my left eye. The coloboma of the iris inhibits the pupil from contraction and expansion so this pin hole contact lens forms an artificial pupil which somewhat controls the amount of light that enters the eye. With the pin hole lens, my visual acuity is 20/200 or borderline legal blindness. I use an additional aid for most of my work at the Lighthouse. This is a +12 high add bifocal lens. If I am looking for a word in the dictionary, I use a 5x power proof microscope.

I am a part time student at Loyola University, working on my undergraduate program as well as working full time at the Lighthouse. Without low vision aids, I would not be able to meet the requirements of either job.

My role as technical assistant at the Lighthouse involves a variety of things. I must arrange the appointment schedules, maintain contact with the referring ophthalmologists, optometrists, and various agencies. I perform all of the clerical duties involved with the program, including compiling monthly and annual statistical reports, as well as making referrals to other agencies upon the recommendation of the optometrist.

Adaptive Visual Training

The average age of the patients who have been seen is 49½ years. Many of these patients have had corrections so that they can do some reading. The lack of interest on the part of the patient, or just frustrations involved with learning to use the aid, results in inability to accomplish as much as he could before he had suffered loss of sight. A large number of patients are referred to Community Services for the Visually Handicapped which is under the Department of Children and Family Services in the State of Illinois. They provide, among other things,

the talking book machine and the home teaching program. Referrals are also made to the Illinois Division of Vocational Rehabilitation. Many of our patients, because of loss of vision, are having difficulty either maintaining a job or acquiring a new job.

One of my most important functions at the Lighthouse is to supervise the adaptive visual training. This type of training is done as a follow-up to the low vision examination and is based on the individual needs of the patient. Determination of a lens or a series of lenses to be tried, as well as the proper working distance, is made by the optometrist during the initial low vision examination. In the adaptive visual training, we strive to help the patient develop an understanding of his visual loss, as well as how he may use his residual vision with successful adaptation to low vision aids. This is very important because many of the patients are not congenitally blind. There are many adjustments to loss of sight. Before one can think of using low vision aids, the adjustments that have to be made must be understood. The patient must then develop good head-hand-eye coordination, as well as learning what illumination is necessary for successful use of low vision aids. Every effort is made to help the patient master his specific visual demands.

Several examples may help to illustrate this point. A couple of years ago, a man who owned a butcher shop came to the clinic and said, "I'm not able to read the scale so I can't weigh meat anymore. I'm thinking about selling my butcher shop." A five doublet microscope was prescribed and he was subjected to several adaptive training sessions. This man was able to master the art once again of reading the scale and is now still gainfully employed in his butcher shop.

Not too long ago a housewife came to us with several visual demands. She could not read labels on cans. She had one three year old son, and she wanted to be able to read nursery rhymes to him. There were also two teenagers in high school whom she wanted to be able to help with their homework. She was provided with a 7x microscope with a flat top segment which gave her a wider field. She is also getting along very well with the aid.

In some cases, the patient must redevelop letter and word recognition. A great number of the patients are not congenitally blind, but have not read for some period of time so that this ability usually returns. In addition to developing word recognition, reading skills need to be developed or redeveloped within a distance of from 1 to 6

inches from the object rather than a usual 14 to 16 inches. This is very difficult for some patients to do. A good example of this is one of my first adaptive training patients. This lady was in her early forties and had suffered loss of sight, secondary optic atrophy as a result of alcoholism. She admitted this quite frankly. She had been an excellent and avid reader. Her vision was minimal, with a very limited field. She was using a 6x microscope. With about ten adaptive training sessions, she could use the aids to read. This lady is now doing quite well and is able to read newspaper print.

Very often we work closely with the Lighthouse Placement Counselor. He came to us several months ago indicating that a receptionist's job in a nearby hospital was available. There was a qualified girl available, but there was one problem. Among her duties would be that of greeting guests who came in to visit the hospital patients. She had a large card file with the name of the patient and room number, but she was not able to find the names quickly enough. She was given a low vision examination and aids were prescribed. At the same time, the placement counselor brought the card file in and all the names were copied with a Flair marking pen. Because of the very slight modifications, the patient is now working succsssfully.

Very few referrals have been directly received from teachers. These have come largely from teachers in the primary levels. When a partially seeing child is in the lower grades, his visual demands are such that he does not need low vision aids. However, it is very important to refer the child at that time if he has a visual problem, or at least to discuss the availability of low vision aids and clinics with the parents. We have seen a number of young children and though we may be unable to benefit them now because of their reading demands, the parents are aware of the service. As the patient returns when he is older and his visual demands change, some kind of low vision aid may be a help.

Report of First Thousand Cases Examined in the Low Vision Service

Last December a study was presented at the American Academy of Optometry meeting in Philadelphia by Dr. Alfred Rosenbloom, Examining Optometrist. I would like to share it with you. The Lighthouse Low Vision Service has been in operation since 1955, and as of today, we have examined over 1800 patients. The purpose of this study was to

determine to what extent a person continues to use his low vision aid and the extent of its use in his life activities. Follow-up low vision data were recorded on 276 patients randomly drawn from the first 1000 cases, who were examined within 6 months to 1 year from the date of the original examination.

The first part of the study was devoted to the nature and frequency in the use of low vision aids. It was determined that 50% of all the subjects under study were congenitally blind and 43% had acquired visual losses. Of the 276 patients, 35% were judged to be highly successful in the use of low vision aids. These were patients who wore their low vision aids constantly, who performed a variety of visual tasks from day to day, and who were very happy and enthusiastic with the results. Over one half of the group has requested a duplicate prescription, and within this highly successful group, two-thirds of the group were congenitally blind. Also significant is that 61% of this group was 19 years and younger when the aid was discussed.

Of the entire group, 27% were judged moderately successful. These patients did not wear their low vision aids constantly, but recorded using them regularly for the purpose for which they were intended at the time of dispensing. Only one-third of this group was congenitally blind and 80% were 40 years and older when the aid was dispensed.

The remaining 24% were judged unsuccessful. The unsuccessful groups were of two types. A small group, 9% of the subjects, may have continued using their low vision aids, but because of senile changes, poor health or loss of vision, their needs and enthusiasm for the aid were seriously limited. In 15% of the subjects, the patients seldom wore their aid or expressed any interest in returning to the Lighthouse for re-examination. Of this total group, 30% were congenitally blind and two-thirds of the patients were 60 years and older when the aid was dispensed.

The above data indicates that 76% used their low vision aids regularly and successfully after leaving the Lighthouse. The age of onset is a very important factor. The congenitally blind patient adapted much more successfully than did the advantitiously blind. Training at the time the aid was dispensed was also very important. The younger patients adapted more readily and continued to use their low vision aids more successfully. It is felt that student age groups are among the best candidates for low vision aids because of their high level of motivation, their adaptive capabilities and greater visual demands.

The second part of the study was devoted to the types of ocular pathology. It was found that choroidal and/or retinal involvements occurred with the greatest amount of frequency in over 60% of the subjects. There were 31% who had primary or secondary corneal opacities or conditions of the optic nerve, and 9% had congenital or acquired anomolies. Regardless, of the pathologic type the most important factors in the successful use of low vision aids were residual vision and functional field of vision. Patients with less than 3/200 vision or markedly restricted peripheral fields were less likely to benefit from low vision aids. Patients suffering from progressive optical pathology such as retinitis pigmentosa, diabetic retinopathy or advanced glaucoma were the least likely to succeed with low vision aids.

The type of low vision aid in relation to clinical outcome was also studied. It was thought that it would be interesting to note whether some low vision aids were used more successfully than others. Within the successful outcome group, over 70% of the cases were fitted with a microscopic lens ranging in power from 3x to 15x or a high plus reading addition ranging in power from +3D to +14D with a median value of +8D. The near vision of over 83% of these patients was improved to the point where magazine and newsprint could be read. Telescopic lenses were prescribed in 15% of the cases. These telescopic lenses included 9 prescription monoculars and lenses made into sports glasses or binoculars. Small segment telescopes mounted in the upper portion of carrier lenses usually in the distance prescription of the patient were also prescribed. Approximately 10% of the subjects received aids involving the use of fixed or focusable stand magnifiers. The use of this aid was often determined by senile changes or occupational preference, inability to adapt to the coordination demands of head, hand, and eye with the use of a head-borne aid, or the aid was selected for use as an auxiliary magnifier.

In summary then, over 70% of the cases of the study are enjoying successful use of the low vision aids. This success was attributed to the age at the time the aid was dispensed, age of onset, motivation on the part of the patient, a vocational or avocational objectives, thorough initial low vision examination, adaptive visual training and follow-up visits or follow-up contact in the form of a questionnaire.

Other services involving allied disciplines were frequently used. For example, psychiatric evaluation was carried out on 15 randomly selected unsuccessful patients.

These studies reveal that 5 patients could have derived benefits from low vision aid, but directly or indirectly refused the adaptive visual training or the recommended correction. It was found that these individuals had at some point in their lives suffered emotional trauma which produced suspicious and hostile attitudes. Of the remaining 10 patients, 6 were found to be in deep emotional depression and 4 did not accept their visual impairment. They seemed to cling unrealistically to the hope that some new low vision aid or some new treatment or surgery would come along to restore vision. Many of these patients had visited a succession of doctors and clinics. One significant finding that emerged from this study was the need for counseling to bring about some acceptance of blindness, especially in patients suffering recent visual loss.

Rehabilitation and Training Programs

On November 17, 1969 the Lighthouse opened the Eleanor Palmer Development Center for blind children and their parents. To date each child has had, in addition to blindness, at least one other handicap, such as deafness, retardation, cardiac involvements or certain physical or birth defects. The mother accompanies the child to the program for a period of 8 to 10 weeks. It is hoped that this training may be extended, but at present too many children are on the waiting list. Currently there are three instructors working with the program and a social worker who supervises the program. The children are taught such things as self-feeding. They participate in a variety of field trips and various other areas of interest around the city. Various climbing devices and toys used specifically to build up muscle co-ordination are being used. Currently we are attempting to set up a program for the optometrist to examine each of these children on their initial contact with the Lighthouse. There are rather scanty reports on these children. They are a problem to examine. Their attention span is short and they are so young -- approximately 3 or 4 years of age. The reports indicate that these children are totally blind, yet we are observing vision when working with the children. They are able to follow lights, objects or special colors.

The Chicago Lighthouse for the Blind also maintains a Sheltered Workshop as an activity center which may or may not be transitional. It also serves as a production or employment center. The training programs provide evaluation, work and personal adjustment, and on the job training. Medical terminology and dictaphone typing, a special activities program, placement youth counseling, recreation, a business enterprises training program, and a college preparatory program afford help for almost any blind person and his individual needs.

LIGHT AND LIGHTING FOR THE VISUALLY HANDICAPPED

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It is almost forty years since I began my career in visual research. It has been most rewarding and I am delighted to be able to come here today and discuss with you some of the important aspects of light and lighting. I have to admit that we have done very little work with the visually handicapped. However, anything that applies to the normally sighted pertains equally well to the partially sighted. One thing we learned many years ago is that light helps those who need it the most. But, an important point is that light and lighting must be properly used and applied in order to gain their advantages.

The purpose of this Institute is to help you do a better job of teaching the visually handicapped. As such, you want to use all the available aids so that the visual abilities of the visually handicapped can be optimized. This parallels what we are trying to do for the normally sighted -- we want all people to realize their visual capabilities to the fullest extent possible. To accomplish this, it is necessary to optimize all seeing conditions. These include the tasks as well as the light and lighting. For example, larger size type usually is provided in classes for the partially seeing. Also, the pupils might use ball-point pens instead of hard pencils.

Many factors are involved when we deal with light and lighting. To put things in proper perspective, I would like to start with a very simple equation:

LIGHT + LIGHTING + VISION = SEEING

Light pertains to the illumination on the task.

Lighting, on the other hand, is a quality aspect and refers to the brightnesses of all parts of the visual environment. In a narrow sense, vision usually is considered synonymous with the eye, but more accurately it encompasses the eye-brain complex. The final product is the human activity of seeing which guides most of our activities.

This equation illustrates the trichotomy of seeing. All three factors play important roles and are interrelated in complex ways. It should be obvious that for the visually handicapped it is especially important to maximize light and lighting so as to help make up for their lack of visual ability.

With this in mind, we can state the primary objective of light and lighting as the creation of a visual environment appropriate to the activities carried on in the space, keeping in mind the people involved. It is evident that stating it in this way emphasizes the human element. After all, lighting is for people.

To achieve this objective, it is necessary to manipulate and control the light for

1. adequate visibility,

2. optimum physiological functioning of the human organism, and

3. appropriate psychological attitude.

These are familiar terms to anyone who is active in the educational field. Their attainment requires knowledge and understanding of many factors and how they influence human performance and behavior. The activities carried on in any space usually vary greatly and involve reading, writing, listening, viewing, art work, etc. There should be little doubt that we want the visually handicapped to have the same broad experiences and activities in schools as the normally sighted.

It is obvious that we must deal with the stimulus-response characteristics of people. There cannot be a suitable response without an adequate stimulus. We have, in effect, a chain of several links -- source, modifier, receiver and decoder. We use our eyes to scan a scene or to look at objects illuminated by a source of light. Then, via suitable optics, automatic scanning mechanisms, photochemistry, microcircuitry and computer-like processes, what we call seeing takes place. While the eye is the important sensor, seeing actually occurs in the brain where the signals are interpreted, evaluated and compared. Thus, a complete understanding of seeing requires knowledge of the relationships among the physical, psychological, psychophysical and physiological functioning of people.

While this is indeed a complex subject, it can be considerably simplified by considering how the eye-task-

surround relationships are influenced by illumination and brightness. A basic need is to see objects so that tasks can be performed. The requirement for good visibility and how light influences it provide a logical starting point for our discussion.

The evaluation of visibility involves relationships among many factors. For this reason, it is impossible to determine lighting requirements merely by inspecting various types of visual tasks. Consider, for example, handwriting with hard and soft pencils, printed material, place names on a map, and sewing with dark thread on black cloth. These could be arranged in order of difficulty, but the amount of light needed for them to be equal in visibility cannot be determined without suitable measuring instruments and techniques. It is evident that these tasks vary considerably in many respects.

The many factors which influence visibility are listed in Figure 1. The starting point, for obvious reasons, is the observer. The inherent physiological and psychological characteristics include the status of his eyesight, his mental abilities and others which govern the functioning of the eye-brain combination. The visual task is described by the size of the details that need to be seen, their contrast with the immediate background, their luminance**, and how much time is available for seeing. These usually are considered the four fundamental factors. However, its complexity and movement (or that of the observer) also will influence visibility. Then, too, there are a number of modifying factors which often have a considerable effect. For example, the lighting conditions to which a person was exposed just prior to performing a seeing task can materially reduce visibility; this typically might be looking out of a window at a bright outdoor scene and then trying to see something in a poorly lighted room. Noise can detract from seeing, as can excessively high or low environmental temperatures. Increasing the viewing distance decreases the visual size of the details; writing on a chalkboard may seem adequately large to a nearby person, but to the pupil in the rear of the room it can be woefully small. Each of the factors in Figure 1 contributes in varying degrees to the visibility of the task. At times, some may seem to be relatively unimportant, but should not be completely ignored.

The eye is a remarkably unique sensing device, unequalled by any man-made instrument. It is sensitive over an extremely wide range of luminances from starlight

**See the glossary of terms at the end of the article.

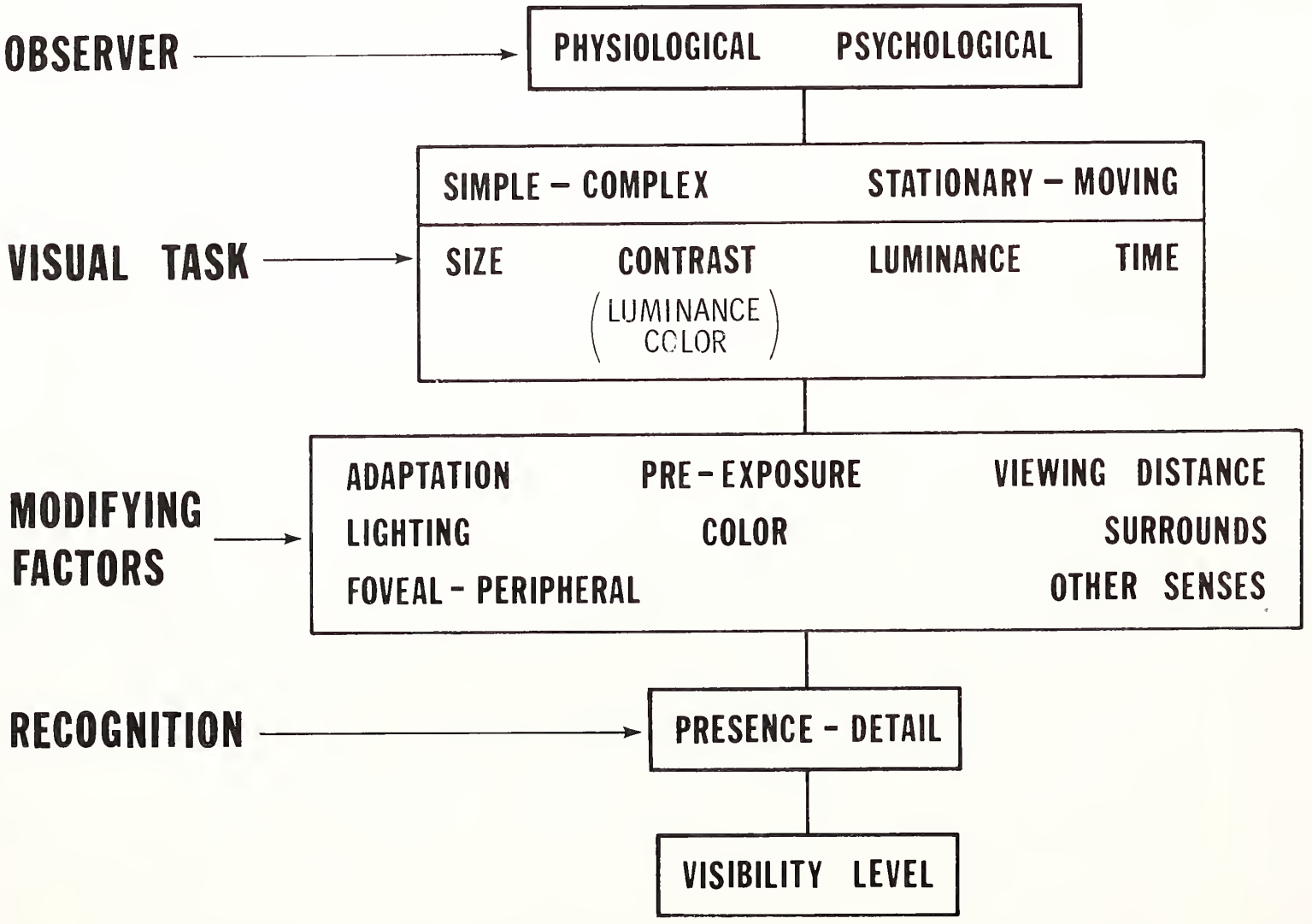

Figure 1. Illustrating the interrelationships among the major factors which influence visibility.

to full sunlight -- a ratio of about 10 billion to one. Even though the eye can function over such a range does not mean that it is equally efficient at all levels. As the luminance increases, we can detect smaller contrasts. This is illustrated by the lower curve of Figure 2 which represents the threshold of visibility. Similar curves can be used to illustrate how less time is needed or smaller objects can be seen as the luminance is increased. Thus, the eye-brain complex takes advantage of more light by responding better. This should be of great importance to the learning process. The quicker and better the eye can transmit an adequate stimulus to the brain, the more time is available for evaluating and interpreting, and then moving on to the next item.

The threshold curve of Figure 2 represents seeing something 50% of the time or being 50% accurate, neither of which is a satisfactory basis for prescribing light. In order to relate the threshold curve to real-life situations, it is necessary to apply a field factor which results in the upper (specification) curve of Figure 2. This begins to take into account some of the factors shown in Figure 1.

Another way of emphasizing how illumination improves visual performance is illustrated in Figure 3. In this case, performance is measured in terms of speed and accuracy. The upper curve represents a high contrast (black print on white paper) task. It can be performed at the 90% level with only one footcandle, indicating that it is of high visibility. Maximum performance is achieved with about 50 footcandles. On the other hand, when the same black print is on a dark gray background it becomes less visible and the performance is only 10% with one footcandle. Even with 200 footcandles, performance rises to only about 80%. In other words, more difficult low visibility tasks require much more light.

The unaided eye cannot evaluate the visibility of objects. However, several suitable visibility meters are available and are being used for establishing lighting requirements. Basically, they are used to relate the visibility of a task to a standard test object for which we have a specification curve (upper curve of Figure 2). If the equivalent contrast is low, more light is needed. Using this procedure, a variety of tasks has been measured and the footcandles for equal visibility determined. These are shown in Table 1. While some are not typically encountered in schools, they do illustrate the need for more light on difficult low contrast tasks.

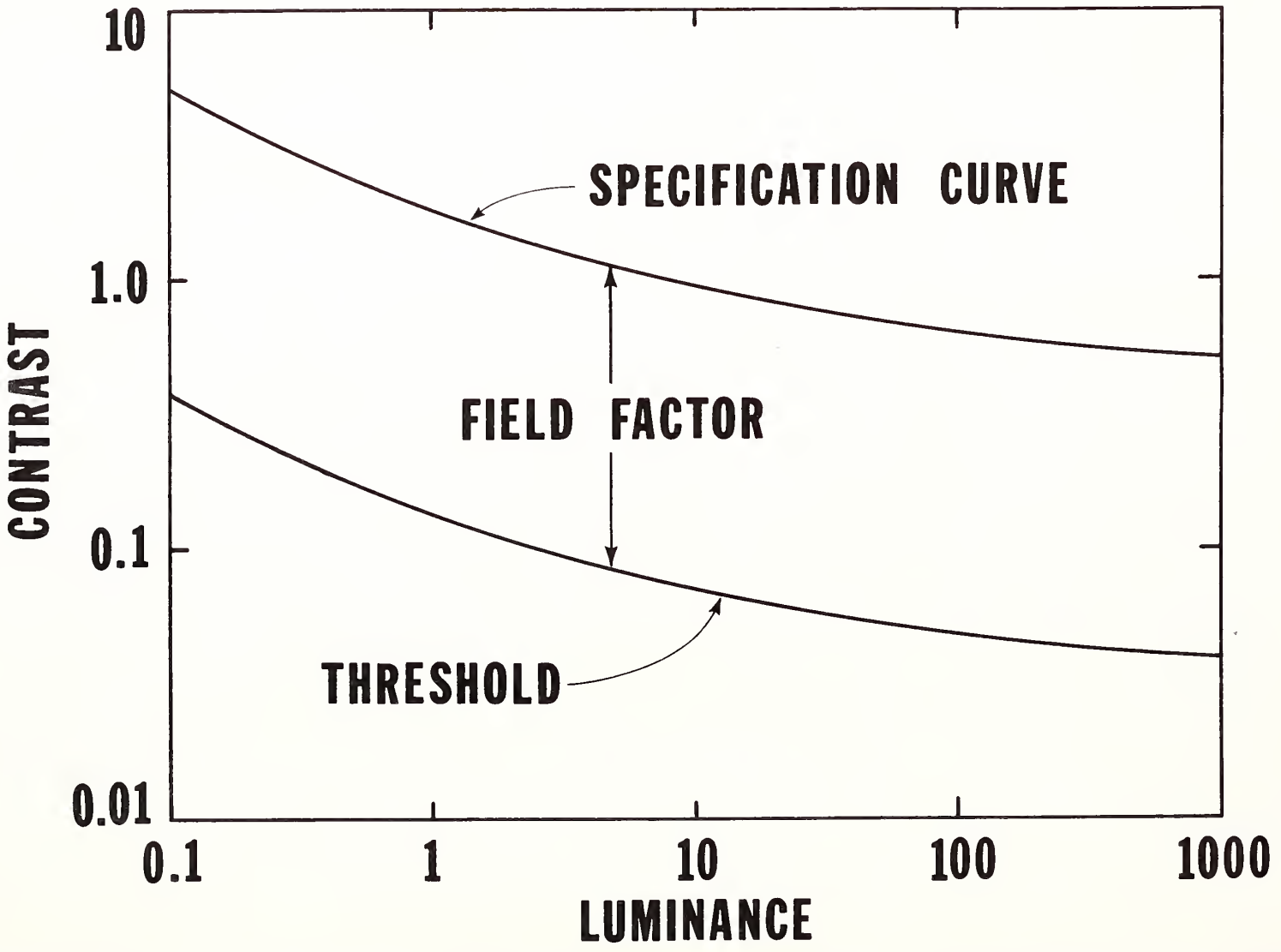

Figure 2. As luminance increases, smaller contrasts can be detected (lower curve). A field factor is applied to convert from laboratory conditions to real-life situations (upper curve).

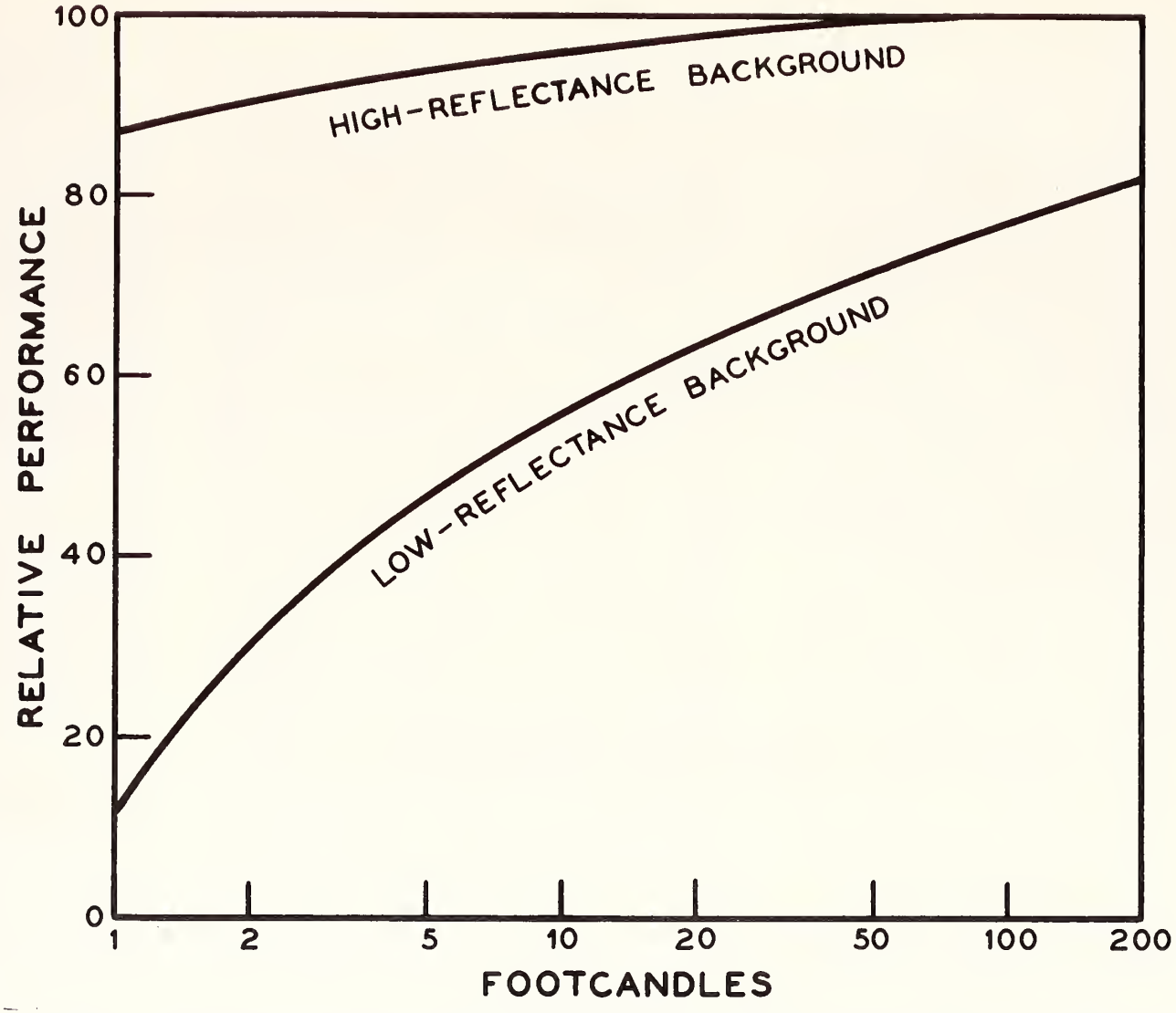

Figure 3. The effectiveness of illumination depends upon the difficulty of the task. Highly visible, easy tasks can be performed with moderate illumination (upper curve). When the task is difficult and of low contrast, much more light is needed.

The visibility and visual performance data I have summarized were obtained by normally sighted observers. A natural question then is how those with subnormal vision respond to light. Several years ago using a visibility meter, we obtained information on a large number of pupils in classes for the partially seeing. With 18 point type as the task, the illumination needed by children with various types of visual handicaps was determined. Similar data were obtained with a group of young adults. The results indicate that on the average, the pupils in the classes for the partially seeing required about three times as much light as the normally sighted persons. Of course, the amount of additional light required by individual pupils varied greatly, depending upon the type and degree of their visual problem. Those with more severe visual handicaps needed as much as ten to twenty times that of the normal group. It should be emphasized that all the children who could be aided by glasses were wearing them. Results such as these indicate most dramatically that most of those who have subnormal vision can be aided by increased illumination.

Another way of illustrating the need for more light by those whose eye-brain complex functions below the optimum level is shown in Figure 4. The lower curve corresponds to the upper (specification) curve of Figure 2, and represents the contrast-luminance relationship for those having excellent visual abilities. The three upper curves in Figure 4 are for various degrees of visual impairment, as indicated by the contrast multipliers. That is, a person with decreased visual ability requires a higher contrast in order to be able to see an object. The horizontal dashed line represents the contrast of a given task as measured with a visibility meter. The intersections of this line with each of the curves indicates the luminance required by those having progressively less visual ability to achieve the same visibility level. This relatively easy task can be seen accurately by a normal person with 4.3 footlamberts (produced by about 5 footcandles on white paper). Those who are visually handicapped need much more light.

Visibility and visual performance are the usually used psychophysical approaches to determining lighting requirements for various types of tasks. Visibility meters make this relatively easy. However, we must also consider the physiological and psychological aspects of performance. The general term ease of seeing is used to encompass the work and effort involved in performing a visual task. We know intuitively that more light makes a seeing task easier to perform. It has been estimated that a quarter of our

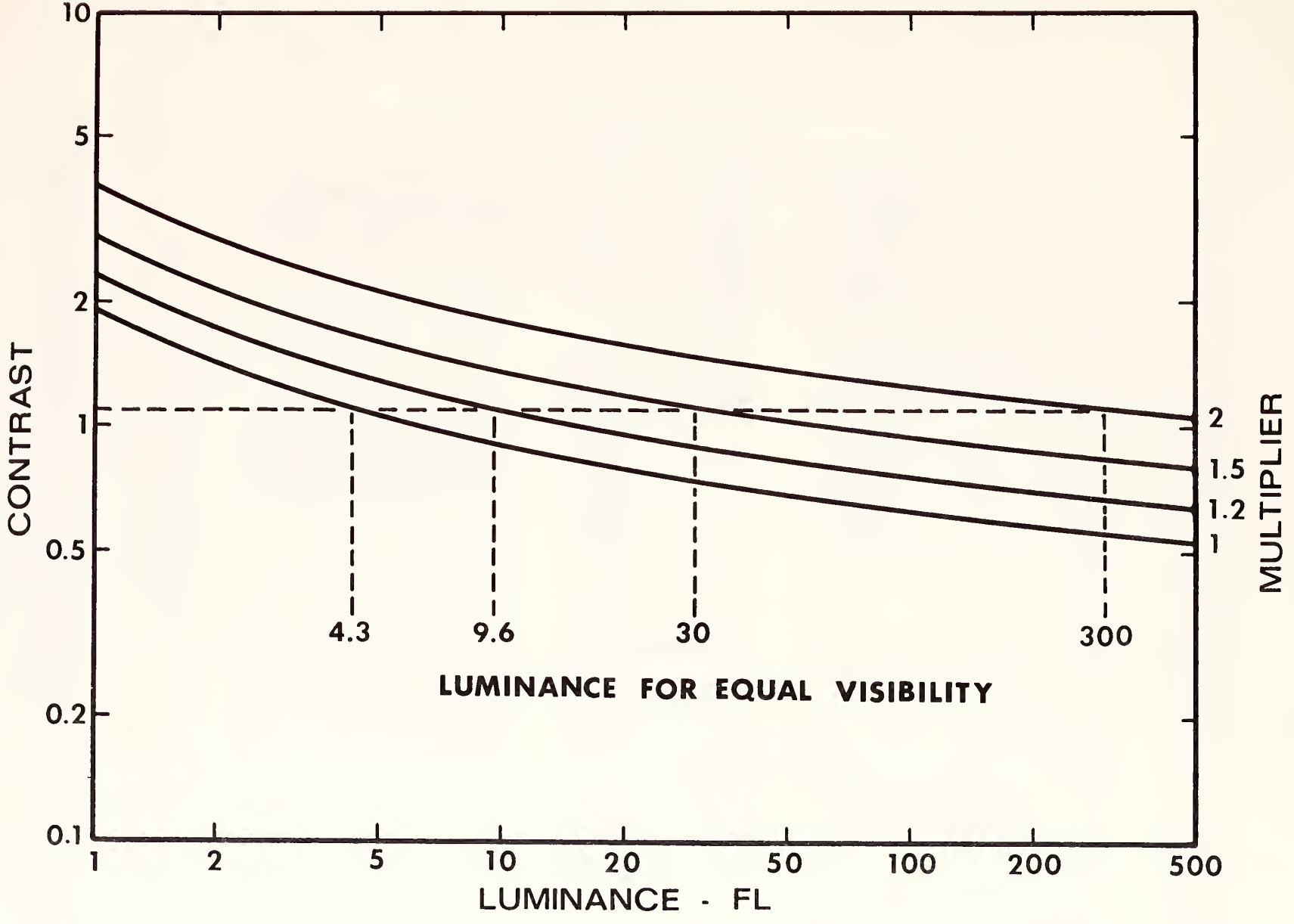

Figure 4. Higher field factors (contrast multipliers) are needed when there is visual impairment.

bodily energy is consumed in seeing, but this is a difficult area in which to obtain useful quantitative data. At present, it is evaluated more or less indirectly in terms of certain physiological responses.

Some typical results of investigations of ease of seeing are summarized in Figure 5. It should be noted that all of these involve continuous performance of a highly visible task -- black print on white paper -- for periods of 30 minutes or one hour. The data show the effect of illumination upon certain involuntary responses of the observers. The three criteria indicate close correlation, all showing greater ease of seeing to at least 100 footcandles. Since all the observers possessed normal visual abilities, it should be obvious that the results are conservative. If the task had been more difficult or involved visually handicapped individuals, much higher footcandle levels would have been required to produce the corresponding ease of seeing.

Up to this point, my primary consideration has been the illumination on the task. However, increasing emphasis is being given to quality of lighting because it plays an important part in the overall effectiveness of a lighted environment. This means that proper attention must be paid to all brightnesses in the visual environment because they can contribute favorably or unfavorably to seeing.

Significant areas are those immediately surrounding a visual task, such as a desk top and even the floor. Extensive investigations in terms of visibility and ease of seeing emphasize that when the surroundings are too bright or too dark they reduce ability to see. For best seeing conditions, it has been found that the luminance ratio between the task and the surround should not exceed about 3. That is, the immediate surroundings should not be less than one-third the luminance of the task. Bright surrounds should be avoided, especially for those whose visual handicaps produce stray light in the eye (e.g. cataracts or cloudy eye-media).

Chalkboards often are important secondary task areas. Generally being dark, supplementary light is desirable. This not only will improve visibility but also will reduce the luminance ratio and thereby make seeing more comfortable.

An important aspect of quality lighting is discomfort glare from overly bright lighting equipment and outdoor scenes viewed through windows. Factors to be considered

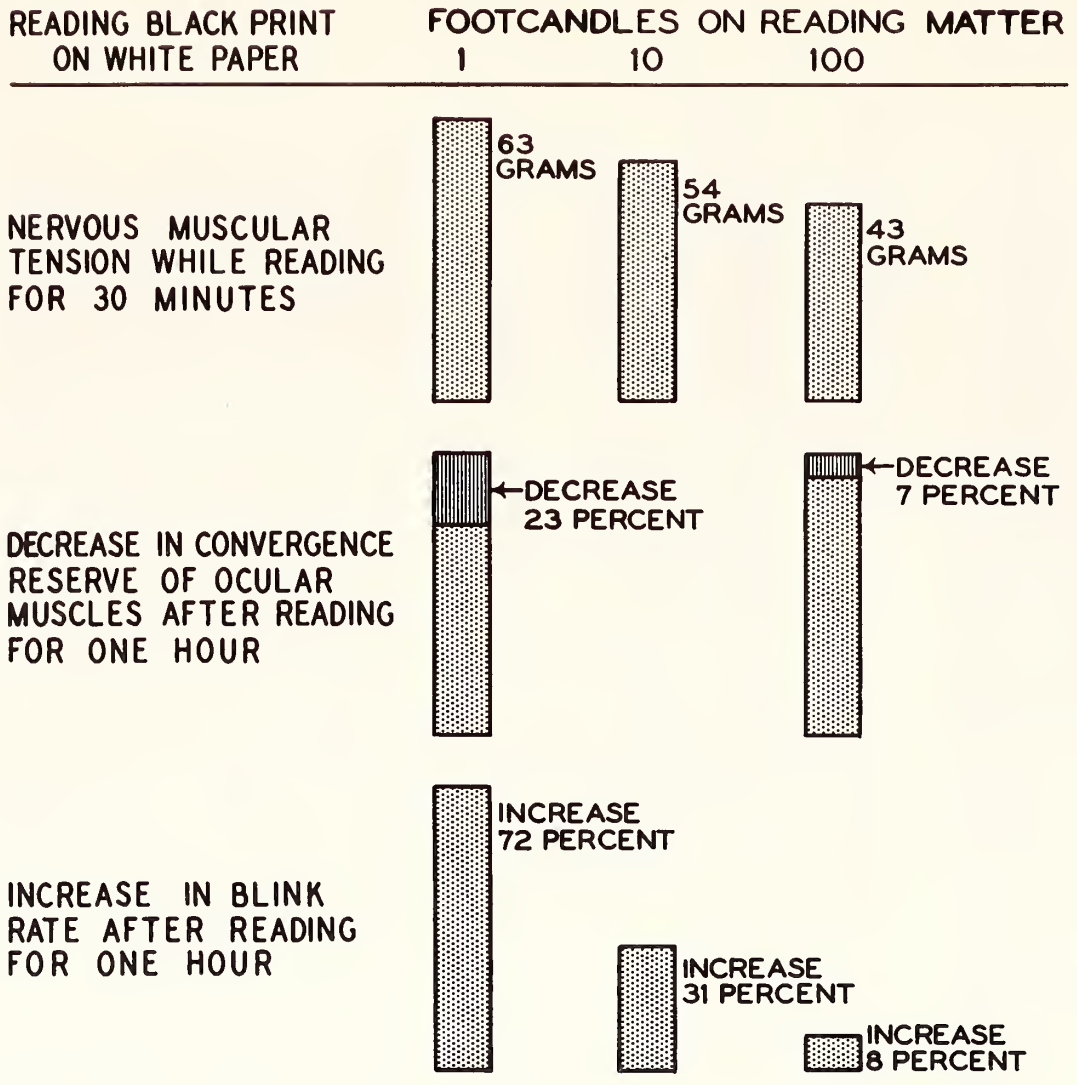

Figure 5. A summary of three investigations illustrating the beneficial effect upon ease of seeing of higher footcandle levels.

are the size, luminance and number of the bright areas, their location with respect to the usual lines of sight, and the brightness level to which the eyes are adapted. The relationships among these factors are complex, but detailed procedures have been developed and are being used for rating the discomfort produced by lighting systems. A simple rule to follow is that the luminaires and window areas should be as inconspicuous as possible. When they are too bright, they will be uncomfortable and even may have an adverse effect upon visibility. Lamps, of course, should be well shielded.

One final problem pertains to what are called veiling reflections. An extreme example of this is the reflection of a light source or bright area from a glossy magazine page. This reflection produces a veil over the printed matter and reduces visibility, often making it impossible to see any details. Even good printing on so-called matte papers can have some gloss. A lighting system may provide what appears to be an adequate amount of light upon the task, but if the luminaires are excessively bright they can produce significant veiling reflections. The placement of desks also is important.

In this discussion, I have briefly reviewed only a few of the extensive researches upon which lighting recommendations are based. It does indicate that we do indeed have a great deal of information available. From this, the Illumination Engineering Society has developed the school lighting recommendations listed in Table 2. It should be noted that 150 footcandles are recommended for classrooms for the partially seeing, which is about double that for the normally sighted pupils. In terms of the actual needs, as indicated by visibility and visual performance (Figure 4, for example), this is most conservative, readily attainable and economically possible. When the entire visual environment is appropriately lighted, taking into account the light on the task and the quality of lighting in the surroundings, the visually handicapped should be able to receive the educational enrichment they need and desire.

GLOSSARY OF TERMS

Illumination - the amount of light incident on a surface or task; measured in foot-candles (fc).

Luminance - physical brightness; the amount of light reflected or emitted from a surface; measured in footlamberts (fL).

Brightness - the subjective attribute such as being dim, dark, bright, etc.

Reflectance - a measure of the capability of a surface to reflect light; it may be direct (mirror-like), diffuse or combinations of these.

Contrast - the relationship between the luminances of an object and its immediate background; equal to $(L_1-L_2)/L_1$, where L_1 and L_2 are the luminances of the background and object, respectively.

TABLE 1. FOOTCANDLES REQUIRED ON VARIOUS VISUAL TASKS FOR THEM TO BE OF EQUAL VISIBILITY.

Task	Footcandles
Typing on white paper	20
Magazine text	35
Handwriting in pencil	70
Newspaper text	70
Shorthand notes	100
Bookkeeping	140
Drafting	140
Telephone directory	200
Medium grade assembly and inspection	250
Metal buffing	280
White thread on black cloth	360
Metal finishing, surface grinding	550
Black thread on black cloth	1400
Precision die making	2200

TABLE 2. LEVELS OF ILLUMINATION RECOMMENDED FOR SCHOOLS BY THE ILLUMINATING ENGINEERING SOCIETY.

Tasks	Footcandles on Tasks
Reading printed material	30
Reading pencil writing	70
Spirit duplicated material	
Good	30
Poor	100
Drafting, benchwork	100
Lip reading, chalkboards, sewing	150
Classrooms	
Art rooms	70
Drafting rooms	100
Home economics rooms	
Sewing	150
Cooking	50
Ironing	50
Sink activities	70
Note-taking activities	70
Laboratories	100
Lecture rooms	
Audience area	70
Demonstration area	150
Music rooms	
Simple scores	30
Advanced scores	70
Shops	100
Sight-saving rooms	150
Study halls	70
Typing	70

THE TOTAL VISUAL SYSTEM -- DEVELOPMENTAL ASPECTS OF FUNCTIONAL AND PERCEPTUAL VISUAL ABILITIES

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The topic of this discussion concerns the total visual system, the developmental aspects of functional and perceptual visual ability. We have, in years past, given little consideration to the total nature of vision.

The development of visual ability is not, as we have thought, an innate, automatic reflex, but one type of behavior of a person in a specific environment. In the last 15 or 20 years, we have come to understand that visual acuity and the great emphasis on visual acuity can be a very misleading factor, because it really is not in any way indicative of how much or what a person can actually see. I began to think about this when people said, "Well, this child is blind." I had been encountering children for 20 or 25 years who had been labelled as blind, and I knew they were not unable to see. They were seeing, they were learning through the sense of vision. This is really what set me off 25 years ago on a search for why this could be, and to determine why we can't do a great deal more to encourage a child to use whatever visual ability he may have and to let it contribute to his learning, rather than putting a label on him and deciding that he cannot see.

More and more concern is being given to the total learning environment and how children really learn. I knew an educational psychology professor many years ago who always started out his class, "I'm really not concerned about you as teachers. You are not very important except as you consider the learner; you facilitate the learning process." I think that many of these changes in our thinking can be conducive to optimal development and can encourage maximum potentialities, regardless of the child's physical and mental capacities.

If we have deviations, which most of us do in one or another of our areas of development, we may not get labelled in a certain way. If we have certain dysfunctions in one or more dimensions of our development, it may be overlooked. However, we need to be aware of these in children very early in life. Parents need to be far more aware; medical and

other specialists need to be far more concerned that slight deviations and dysfunctions may interfere with the normal developing process.

However, deviations and dysfunctions do not preclude the possibility of development of these processes if we manipulate the environment; if we are somehow more creative in the use of certain materials, and if we as teachers slow down and let the child set the pace for the learning process, rather than our deciding that he should learn at a fixed rate. I think one other thing that we as teachers have to be extremely sensitive to is that the child can tell us what he is ready to learn if we just tune in to him, watch him, listen to him, and involve him in this process of decision making about what he is ready to learn. We have a tendency as teachers to do just what I am doing with you today -- to stand and talk to you, at you.

There is a very fascinating book written by Silberman, Crisis in the Classroom. Dr. Silberman tells about an experiment in which the children guide the learning process. The teachers are there to manipulate the environment. They are there to change the materials and the things in the learning setting. However, learning is a child's business. I think maybe we have taken it away from them to a great extent and have not permitted them to set the pace for learning. These are the things that we have to keep in mind as we talk about visual learning, especially with children who have impairments of some nature.

If we are to have a complete understanding of visual stimulation and how we can assist a child who has some impairment in using whatever visual ability he may have to its maximum regardless of his acuity, we have to have some knowledge of the visual system. Frequently, we think that we are talking only about the eye. In reality, the eye is a very, very small segment of the total visual system.

What is vision? Vision is a process. It isn't something that one has or doesn't have; it really is a process that includes the ability, among other things, to look at marks on paper which are symbols that stand for things. When we see those marks on paper, we should know the object that the marks stand for and what the object looks like, sounds like, tastes like, smells like without actually feeling, listening, tasting, smelling or looking at it. Vision in the broadest sense is the end result of all our other dimensions of development and not the starting point, as we so frequently think. Perhaps you may not agree with this, but I hope you will think about it. If vision were the starting point, every infant would fully understand everything he sees at the moment of birth. There would be

no need for this long, involved process of learning. Neither would there be a need for long periods of infancy and childhood in which to learn.

Vision is much more than an ability to see clearly at a distance. It includes the ability to know distances without having to measure them, to know sizes and shapes without having to put our hands on them and feel them, to know the position of things and their relationship to one another, and to know up, down, sideways, and backwards without actually having to move our bodies along these dimensions. Vision is learned, is developed. It isn't something that we have or don't have. If he has no impairments in his body systems, the normal child does not have to be taught to see. His visual development is incidental in nature. It just comes about. Why? Because we live in a world in which there is light and in which there are always things to see. There is no way to escape developing if there is some normal ability and normal sensory organs. Developing the visual sense and process is incidental because one cannot escape the bombardment of visual stimulation. What we must consider is that incidental development and learning does not go on when there are impairments, and we must in some way facilitate that development in children. We may tend to take visual learning for granted. We say the child has such and such acuity and he will learn to use it. He really won't in most instances unless we assist him.

Henderson says, "Each eye transmits as much information to the brain as does all the rest of the body." The eye exists - all sensory organs exist - for one purpose. All our sensory nerves exist for one purpose, to feed information to the brain. Bateman uses an information processing model to talk about visually handicapped children. After all, the brain is an information processing center. The senses exist for the purpose of sending messages to the brain to give it information. This is why we may want to look at visual stimulation as a part of the development.

The eye is physiological in nature -- it either functions or it doesn't. Its first function is to transmit light. In order for the light to be transmitted into the eye, we must have a fairly clear portion in the cornea because the cornea, along with some of the other parts, actually refracts the light rays. All other parts of the eye, except the retina, exist for the sole purpose of transmitting light rays onto the critical areas of the retina. If there is an abrasion in the cornea or if there is a cloudy cornea, there will be an interference in receiving the light rays. However, unless the cornea is totally covered, some light rays may still be able to get in.

If there are cataracts, some of the light rays will be cut out, because they have to pass through the lens in order to get to the retina. If they cannot go straight through, there is a problem in focusing. The eyes are turned in such a manner that there is a point of focus that bypasses the cataract. Think about the child with a cataract and his need to search for a point of focus. Let us think about something else in a child with a cataract -- if his point of focus must be off the retina, he is going to have to get material at an angle so he can focus on a peripheral area in the retina. These peripheral areas of the retina are not as sensitive to bright light -- they are the areas of the retina that function best in dim light. There is a cue in terms of working with a child with cataracts -- he has to have controlled lighting conditions. Bright lights and sunlight blind him.

The albino cannot automatically and reflexively control the amount of light he wants. That is not built into his system as it is for the rest of us. The albino has to have light controlled for him in various ways.

The next aspect of the visual process involves the retina. We have to talk about the retina very separately from the other parts of the eye because the retina really is made up of the tiny nerve endings that are an outgrowth of the optic nerve. Sensory receptor cells spread all over the retinal area where these tiny nerve receptor cells contain a chemical fluid activated by light rays. The retina can receive light rays under conditions that we would never expect. It does not take much to excite a receptor cell in the retina; it does not take 20/20 vision to get some action in a receptor cell in the retina. What occurs if one has only a few receptor cells in the retina being stimulated? One simply has a less intent message getting through to the brain. This means that the few cells have to be stimulated for longer periods of time and there must be greater practice in order to get the same message. It is comparable to a dripping faucet. If one can turn the faucet on all at one time, the cup is filled immediately. But, if one has to drip the water, it takes a long, long time and a great deal of patience. In the end, however, one still gets a full cup of water. If we think of stimulating the retina cells to get information to form a visual image into the brain in a similar manner, perhaps that will help us to understand that we <u>can</u> get the message to the brain. But, if there are only a few areas through which the message can travel, it must take a greater period of time and more work to get it done. The child with chororetinitis must work very hard to find a portion of the retina which can pick up or transmit a

message. Only that portion of the retina which remains next to the choroid is usable. The cells die in a detached retina, and can no longer be activated by light.

The second function of the visual process involves the neurological aspects. The optic nerve is really the transmission system, because the light rays generate a certain chemical which in turn activates and causes neuro energy to be transmitted across the optic nerve into the brain and all the way back to the occipital lobe. There are many things to be concerned with in the optic nerve area. First of all, these other aspects must function well -- the physiological aspects, light rays, and refraction. Then, the receptor cells must work well in order to get something transmitted through the optic nerve to the brain. A lot of things can go wrong in this process. There may be an under-development in the whole nervous system that causes nerve endings in the optic nerve to begin to break down or to atrophy. There will be a distorted message getting across -- a garbled message, an incomplete message of some sort. It is thought by many that the light rays which enter the eye and fall on the retina, sending the messages across the optic nerve, actually facilitate and feed the nerve myelinization process. Nerve myelinization is actually the development of insulation around the nerve fibers to make them stronger. Myelinization may be dependent upon light entering the eye. If a child has had cataracts for a long period of time and has had those cataracts removed, we must be sensitive to the fact that his optic nerve fibers may not have become well insulated as yet. It will take a lot of exposure to light and over long periods of time before this process can be completed in order to facilitate the sending of messages to the brain, which is really the receiving station. All sensory organs, all other body processes function primarily to provide the brain with information in order for human beings to be human beings.

In the brain is the occipical area, to which we are seeking to get the messages in order for a visual image to be constructed. We do not see with our eyes, we see with our brains. We do not have to have a complete message to get a complete picture in the brain. Once a person has constructed a particular picture, we have what we call a mental visual image of it.

The next most strategic factor is that the various areas of our brain serve as receiving centers for the other sensory organs and also for the motor nerves. There have to be connectors between all the different areas of the brain in order for us to ever get a complete understanding visually, auditorilly or through the senses.

To have a concept and to be able to think, we must be able to put information from the sense of hearing along with information from the sense of seeing, etc.

Question: What kind of an image does a person with one eye get? Can he turn the image around?

Response: Some confusion has been caused by our thinking of the eye as functioning like a camera, and there are some people who suggest that is a wrong way for us to try to think of the eye. We get that impression and try to translate this in a very literal manner. It cannot be translated in a literal manner. The light rays do fall on the retina and stimulate the cells, but there is no image on the retina itself. The retinal cells pick up messages. The nerves in the optic nerve from each eye divide at the optic chiasma and half of them go to the left and half to the right. So, if one sees with only one eye, half of those messages go to the left side of the brain and half to the right area of the brain. The occipital lobe has two sections. There is less stimulation, but one can construct a full image and does not have to fuse two images. A person with heminopia who has some kind of a tumor that has interfered sees only with one half of one eye and half of the other. He has to put it together in the brain to get a total image. This transfer of nerve fibers at the optic chiasma is the further clarification process, as the messages get back to the different areas of the brain. Probably this likening to a camera and our talking about inverted images and so forth was done for the purpose of trying to give us something that we could understand, but maybe it has ceased to be useful now that we have begun to understand and realize that vision is a lot more useful than an image that is flashed on the retina. We need to discard this idea and think a little bit more about the organs of the human body and how they function.

Question: Are there some who question the theories that light strengthens the eye? Why?

Response: I really don't know. If one is interested in looking at it from a theoretical point of view, D.O. Hebb had the idea that the more messages transmitted over the same nerve fibers, the more rapidly the nerve fibers can function and transmit those messages. The transmission of those messages enables us to have receiving stations along the way in terms of what he calls cell assemblies, where we put together what has come in and then have connectors with other cell assemblies. We do not know how

the brain constructs cells, but this constant stimulation would seem to then facilitate cushioning around these nerve fibers. And, it goes back to the use of our muscles. Muscle growth and cushioning is facilitated by the use of the muscles. If we don't use them, they waste away.

Question: What about the theory that neurological reorganization takes place in the brain?

Response: From what we know of the brain and its organization, once a brain cell is dead it cannot be made to function again. One cannot rejuvenate a dead body cell. The theory referred to suggests that we can neurologically facilitate reorganization. There is no evidence that this has actually been done. To me, it relates more to the fact that the more one does something with or for a person in body movement, the more one has facilitated the person's ability. But, I think we have to be very pragmatic and very realistic. Everything that feeds information or that relates to the development of the body process is influenced by emotional and psychological factors. That probably begins in uterine life, in the last several months of embryonic development. We certainly know that it begins with the first breath. Probably the most influential stage in the development of emotional and psychological processes in the human being is the first 18 months of life over which we as people can exercise very firm control. One book talks about stroking as a part of emotional and psychological development. The importance of this is that any child who is manipulated and stroked periodically over periods of time is going to have a very positive emotional and psychological influence. Whether it changes his mind or not is not known, but he is going to see the world as a different place and people in relation to him. I don't think any one method will always work with all children. But, I doubt if any one method of anything is superior in and of itself or as a method over anyone else's method. However, one is losing sight of the child when he takes a method and applies it. The important thing is to know many methods and how they are useful, and most of all to know the child.

Question: Does the person with nystagmus have trouble getting as much visual information?

Response: We don't really see as well when we hold our eyes for long periods of time in a fixed position, because movement and motion are really what give us the dimension, the contour, the spatial perspective. It is normal and natural for the eye to move over objects and energy. There has been no evidence that I am aware of

(and I have not studied this in depth), to suggest that a person with nystagmus does not get as clear an image that he can interpret as easily as a person who does not have nystagmus. He may have to work a little bit harder to steady his eyes for minimal fixation time. Unless the nystagmus is of such a marked nature, I think that probably the people around get more concerned about the condition, in terms of interference, than does the person himself.

There are three terms which are certainly involved in this total visual learning process and which have a great deal to do with our understanding as teachers of what we are really talking about. We must differentiate between them and put them in their proper perspective if we are to use them in the best way possible. As we talk about the total visual process, its growth and its development, we are concerned with acuity. It is a factor, but what is acuity? It is a measurement of the ability to discriminate very clearly the fine details of objects or symbols at a given distance. The only thing that it is indicative of is the reception of visual stimuli by foveal cells in the retina. Put the term in perspective and utilize it properly.

The next term is a far more encompassing term, visual perception. Let us look at what the term refers to and what is involved in visual perception. Perception refers to those neuro-physiological factors which we talked about earlier. It involves the processing, the coding, the interpretation of messages that we get through the visual sense. Visual perception, in simple terms, is the ability to use the visual sense to gather meanings from what we see and the ability to interpret what we see. This requires that we can receive visual messages through the sense of vision, but it also requires that we have a frame of reference, that we have been taught the relationship, the commonalities. Eleanor Gibson defines it in her book Development of Perceptual Abilities as "the learning of how to pick out the discriminating cues", to know the difference between. What is it about this particular object I am looking at that is distinctive and gives me a cue that it is not like this object over here? All of us who have "normal vision" are able to discover this incidentally. We focus on a discriminating cue, we know how this does not look like this. With children who have low vision, lowered acuity or any kind of impairment, discrimination has to be taught. We have to work with them and walk them through the process of picking out the distinctive cue so they will be able to make the differentiation between the things at which they look.

Visual efficiency is the thing we are concerned with. It is the most inclusive term we can use. What does it really mean? It relates to many things. It relates to the management, the control of the visual mechanism itself, and to the focusing ability, the holding, fixating on an object until we can get a picture or a message through. It encompasses the tracking ability in order to permit us to follow motion and it encompasses the ability to give contour or three dimensional quality to objects in order to help estimate distance, etc. We have to control the mechanism, whatever mechanism we have -- whether it is of good or poor quality. Learning about the control of this mechanism is where we have to work with the children -- learning to fixate on an object, to hold it there, to follow around the contour, to know that it has a form, and so forth. Visual efficiency also relates to the ability of the transmission system. How fast do messages get in? How strong do they have to be in order for us to put them together, sort them out, filter them, so as to determine whether they can be useful to us? The third factor in visual efficiency is the actual ability of the brain itself to take a little bit of an image or take a very distorted image and translate that into or relate it back, to associate it with a known image. Again, efficiency is what we are really concerned with. It has something to do with the eye itself, with the mechanism, with the quality and quantity of the messages that get in, but it has a great deal more to do with the brain and the processing abilities. These are things which the child learns in his total learning process which come about over time. The child isn't likely to begin to instantaniously have the ability to be efficient. That is a part of the teaching process.

Let us go back to the term stimulation which we talked about earlier. The more a child is stimulated, given things to look at visually, the more he develops his discriminative abilities. He looks at things over time and says, "Oh, this isn't obvious or it is obvious." He learns to pick out all of the distinctive cues. As he learns language (and we work with him in learning language), he enhances his interpretative abilities, because language enables him to interpret images.

Some people do not see a difference between sensation and perception. This is a point at which psychologists are not in agreement. Some of the behavior psychologists use the two terms interchangeably. I do not believe that the terms mean the same thing. Sensation is simply the stimulation of the retina cells. In order

for perception to take place the messages have to be transmitted and interpreted. To use sensation and perception interchangeably, I think, is to confuse them. People in this particular field of study are having great difficulty communicating with each other because they are using terms like sensation and perception to mean the same thing.

Stimulation is something that the human organism hungers for. We have sensory organs in order for something to get into the human body. There is a hungering for information; for the sensory organs to be stimulated. If the child has light perception, he will follow the light. You have seen it in infants and you have watched it in children. They are always seeking the light. In the films on rubella children, this is the most outstanding thing. We have a tremendous challenge here. These children are very damaged but almost without exception we find that the one persistent characteristic in almost every one of them is a mania and preoccupation with a search for light. This is indicating that the whole central nervous system has a hunger and thirst, and it must be satisfied. If a child has light perception and we don't move him beyond that point - just seeing light - then we are putting an impediment in his way in terms of learning. If he can see light and be stimulated by it, then we need to move him to the next stage, giving him something that can begin to form an image or be formulated as a form. This is the way perception develops. Studies of infants show that the organism moves rapidly from this "light seeking" to begin to get emergence of a form that doesn't have distinctive qualities in terms of early visual development, but seems to hang there in space as a blob. We have shown that this can apply to children who come to us at 6, 8, or 10 years of age who are impaired visually, but who have never used this sense for learning. Yes, I think we have shown that this can be done.

This process even works with much older children who can learn to find the form, but who have never really looked at things before. We have worked with children who didn't know how to control their visual mechanisms. Their eyes just seem to wander around, like many visually handicapped children. But if the light can get into the eye, they can be taught to fixate. This is where we have to start. Perhaps we start at too high a level and before we give them a picture to look at. They are at that stage of development. We can teach them to follow a light or give them something that has very good contrast and let them look at it until they can actually fixate and find that place where they can get the message through.

I looked at one little girl who was the child of two totally blind individuals. Specialists had even gone so far as to put lenses on her, but she was not developing in terms of responsiveness to any particular visual abilities. One can understand why. She had no stimulation. There had really been nothing for her to look at, nothing taught. She had very limited incidental vision. When I first started working with her, she had no idea how to fixate and to follow around the contour of an image which she could actually see. As this began to emerge over a period of a few days, she became very excited. Somebody had told her that she was blind, and all along she had been treated as if she were.

The familiar story of Joey, "The Boy Who Found the Sun" (which appeared in Redbook several years ago), dealt with a child whose mother was totally blind and whose father had limited visual ability, but functioned very well. The child was born prematurely and also had cerebral palsy. Because he was with his mother most of the time, he experienced her world and lived her life, functioning as a blind person. This child was not stimulated visually. Therefore, he could not respond visually. He had absolutely no visual perceptual development and he was even diagnosed by some unknowing person as blind. The parents got very concerned. Naturally, with cerebral palsy, when he tried to move around he bumped into everything. Everybody was thoroughly convinced, on the basis of this child's behavior, that he was blind. When he was taken to someone who observed him carefully, the parents were told, "There's really nothing wrong with the child's eyes. We don't know why he doesn't see." To make a long story short, they finally got him into a kindergarten or a nursery school. The Sisters let him work and do things with the other children. Finally, they noticed that the other children were saying, "Look at it Joey, look at it." The child really didn't know how to focus his eyes. Nobody had ever sat down and said, "Look at it." One little boy came up to the teacher one day and said to her, "I don't know what's the matter with Joey but I know one thing, he just can't use his damn eyes, and we've got to teach him how." The children were even perceptive of this. They knew he could actually see. They began working with him and, sure enough, his visual perceptual development came right along. This child would never have really developed perceptually and visually because of the inaccurate kinds of messages or the reception of messages. The father got a neighbor to come in, hold a book, ask the child to point to things. The child would put his

hand on the book. Why? That is what he saw his mother do, naturally. I ask the question, "What is the one revealing thing in this story that indicated that Joey had vision?" The fact that he could imitate everything that his blind mother could do. Perceptual development will never come along without teaching. The actual acuity possibility may be there, but the perceptual development must be taught.

In the beginning of perceptual development all images, all impressions, are very unorganized and anything the person looks at is very vague. It has no contour or shape -- it is simply a mass. As the search for meaning comes about, a much more analytic process begins to develop. What is looked at begins to have some kind of field. In other words, there is an object within a field. The person begins to make the discriminatory cues. The object begins to stand out from the background. There is some detail and visual perception begins to develop. There is a series of films to be made on visual perception that will bring this out very clearly in observing young children's behavior and their development of object constancy. A child has to look at an object, learn to manipulate his body in relation to that object, and focus on it over time before the object maintains its constancy. In other words, it always appears the same when he sees it. This comes about through stimulation and development. It is not an instantanious process. Douglas talks about this in terms of, "We construct our visual images." Next, we assimilate and associate. The brain puts together in this assimilation the image that we saw previously with an image that we are seeing now, and we make the differences. We relate them -- it is like this one or it is different from this one. Only then can we reach a point where we can actually respond to the image with some degree of consistency as to how it appears to us.

There are other factors we have to look at in children. To get all of these things to function physiologically, perceptually, etc., we have to get a child to attend visually. In other words, he has to give his full self physically, mentally and emotionally to the material we give him to look at. In order for him to ever interpret it, he has to learn to attend, and we have to bring things within his visual range to get him to attend. He is not able to go out and get them himself or to learn to attend to them. One of the things we need to consider in visual stimulation is that we encourage, support and manipulate visual materials until the child is ready to attend

to them and will attend to them. Only when he is attending, giving himself, can he become aware of the fact that this is something unseen. When he is aware and picks out all of these discriminating features and when he is presented with the same thing over and over, he learns the language that goes with it to describe its contour -- whether it is round or straight or has points or has corners. Can he then recognize? Recognition in terms of visual stimuli is a much higher level of brain function than discrimination. I can look at something and know it is not like something else, but recognition is made by putting a name or a label on it. We can discriminate and know the difference between -- we can match and put things together, but we may not be able to recognize. There is a hierarchy in terms of perceptual abilities -- recognition comes after discrimination. How do you know when a child has recognized something or when he is making a certain level of discrimination or association? When he can respond! But how can he respond? He can respond through visual motor acts. If he can see a mark and can in some way duplicate that mark, that is a response. If he can use words, that is another kind of response. If he can give any kind of a response that says to us, "Well, he sees something there," then we know that he is developing some visual perceptual abilities. Any time a child is able to attend, get something from what he is doing and looking at or give a response, he immediately has a feeling of satisfaction. I could see that; I could respond to it. Then he is ready to repeat that; he is eager to do the same kind of thing again. Sometimes we fall short in that we stop. We don't give him time to respond and we don't enjoy with him his satisfaction of having done this. Then, we don't provide him with the opportunity to repeat it sufficient times until it can become an established pattern.

Visual perceptual ability involves something more. It involves a decision making process. The child has to make decisions. Is it like this? No, it is not like this! Well, why isn't it like this? Well, it isn't like it because this one is round in this corner, and this one has a corner there or it has a point. A child who has an impairment in his visual sense will not be able to spontaneously and incidentally learn to make these decisions on his own. He will have to be taught how to note the discriminatory features, so that he has a basis for beginning to make a decision.

How does this whole business of visual and perceptual ability growth and learning take place? As far as we

are able to tell, the first thing is that we have to get the child ready. We have to get him to control his mechanism and to use this control. It may take quite a long time. When we do present him with the materials, we ought to present materials that require him to involve more than one body system, not just the visual system. Research is suggesting that the more body systems we can involve, the more we are going to strengthen any one system and its perceptual development.

We start out with things a child can hold in his hand, can touch and also see -- the geometric forms which are all around us in our environment. The whole world is designed on the basis of a linear perspective or a curved perspective. Geometric forms are the simplest. If we start with them and teach the words and the language, the children learn to discriminate. Then, we can put these same forms into a representation and let the child look at it. He can develop a visual image because he has held it and has something to relate it back to. When he sees something round he can say, "Well, that's a ball or that's like something else," something which is known to him, so he gets that much more out of it visually. Whereas, if we present him with something that isn't known to him, he has no frame of reference, relationship or association. We are giving him something far beyond his perceptual ability to interpret.

Moving from the simplest forms, we can present forms for object perception because objects in the environment incorporate all the basic geometric forms. But, objects have a greater variety of distinctive contours and it gets more complicated and complex to discriminate objects. We can let the child handle, smell and taste as many objects as possible. We can put those same objects in outline form or in solid form on a piece of paper. He then has a frame of reference in order to interpret this visually. It really means something to him.

Another thing we have to think about in perceptual development is that we can't take too many long steps at one time. We have to go through very short steps with a child. We don't give him a variety of objects of a different style, kind, class, etc. We start first with objects that are familiar to him -- toys, clothes and food. We let him learn to form visual images of all these things. We get him to group all objects that do the same thing, all objects that are similar, which enables him to code them in a different way as he puts

them in a class. Then, we get him to look at what objects do for us and move then into an action. When we teach the parts of speech, we start with the noun first because nouns are the names of actual things. Then we teach verbs, for that is something that one does with objects and with the body -- action kinds of things. We need to plan what we are doing visually so it fits into what we know about the introduction of things. We have to take the children through each step of sorting and categorizing all of the objects, pictures and other things that we give them. They must have the opportunity to put all the things one wears together, all the things one plays with together, all the things one uses to eat together, and so forth. Only when the child can do all of these things singularly is he ready to look at a picture and clearly perceive visually not only the objects but the action in that picture. That is what he has to be able to do if he is to get the full meaning from the picture. Only when he can do all these things well through the visual sense and interpret them is he ready to be introduced to symbols -- in the form of letters and words.

That is fairly contrary to what we ordinarily do. The first thing we do is put a book out and try to teach the child letters. But, he doesn't have a frame of reference for relating and associating. He doesn't have a store of visual memories because he didn't acquire them incidentally. If he has an impairment in his visual sense, he has to be taught from the very beginning. We start with him as if he were an infant and take him through all the visual learning experiences before we ever hope that he will be able to handle symbols. The interpretation of symbols is the highest form of abstract thinking required. One doesn't jump from a base line to the highest form of abstract thinking. It is a process that goes on over time and the child has to learn it. Only then, after he can recognize symbols singly, can he put them together in the form of a sentence. A child who has an impairment in the visual sense is an individual. Individual children are known to have all kinds of interfering factors in terms of sorting out these things. If we can stimulate the child sufficiently that he moves from a blur to getting enough messages that he can construct an image in his brain, we have helped him. Many of our visually handicapped children never see the totality of a visual object simultaneously. They don't have enough vision to see the whole thing, especially if it is large. They have to see parts of it and be able, in the brain, to construct the

parts into something which they know. That is why a child may have to move around something that we give him on paper and look all the way around it. Then he has to build for himself what that is totally and how it looks when it is all put together. It is a very important thing because this is where his brain must function properly.

Question: In the story of Joey, the one who saw the sun, I think it was made clear that things look different from lying and sitting positions.

Response: Joey had cerebral palsy and was unable to move about on his own. He sat or laid down most of the time. That is a very good point for us to think about. Our visual perceptions in a prone position do not give us the same images as those we get from a standing position. We don't get the same dimension of qualities of the environment or the objects in it from a sitting position, a lying down position or a standing position. The child, in order to develop perceptually through the visual sense, has to experience all these movements and look at things from all positions, or he never develops what we term spatiality or object perspective. Perhaps he thinks he is seeing a different object when he looks at it from another angle or point of view. I think this was Joey's problem since he didn't walk in the beginning and laid down a lot. Nobody called his attention to things, and he had no visual language developing along with it.

Question: How far can children go in learning to see if they are impaired?

Response: That is a very good question. I wish I could answer it. I think the teacher is the person who must determine how far a child can go.

Question: Does it differ from child to child even when they have the same impairment?

Response: That is true. I think the wisest thing we can do is to keep an open mind and read the child and his behavior rather than make a priori decisions on the basis of acuity or something else, that he should do this or he should do that or he doesn't have enough vision to use it very much. Any child who has light perception and can get even a blob of contour knows more in terms of being able to use it and functioning than a child who has never been taught. If a child can just get a vague contour of the line

as he approaches, this helps in terms of travel and mobility more than if he had not been taught what that particular contour means. To hold an open mind that children learn to see depends on the opportunities we give them, the manner in which we stimulate, the attitudes that have to do with the child's image of himself and how he feels about the things. Every teacher has to use his/her own good judgment if he/she has an open mind and an understanding that the use of low vision is definitely learned. I don't believe we have any reason to question that because we know that visual perception is learned; it is learned in all levels, and we have some very strong plus factors from research.

I wonder if we are not as teachers sometimes very concerned with making some kind of decision about reading mode? I haven't discussed reading mode purposely. I have been talking about learning. We talk about reading and forget that not all children are ready to read and that learning precedes reading. Often with handicapped children we need to start at a much lower level. We really should not be concerned with reading. We need to expose the child to all possible means of learning. At a very interesting discussion in an Institute, a gentleman was quite adamant in that he thought teachers should make decisions and tell children what to do. I don't agree with this at all. In the first place, I think the children have taught me far more than I have ever taught them, and that is the way it should be. I think if we try to make the decision that, "He is going to be a braille reader, or he is going to be a print reader," we get hung up and forget that we are interested in learning. I am talking about children who have very limited visual capacity. Probably the majority of these children should and could, if we permitted them, use both their vision and tactual ability in reading and interchange them in terms of fatigue, in terms of what is available, in terms of what they are doing, the situation, the lighting conditions and other things. If we could just hold ourselves back a little bit and not try to make a decision for the child or expose him to only one means of learning, most children would be perfectly capable of making this decision for themselves around the second, third or fourth grades as to the media they want to use primarily. If we deprive any low vision child of developing his perceptual abilities for the purpose of learning and reading, we are placing an impairment on his whole life. If he has some low visual

ability and can be taught to develop that perceptual skill to the highest point, he has the rest of his life to strengthen that visual perceptual development -- not whether it is perfect or not, but to be useful to him in his living and learning, and in relation to other people. I don't talk about visual stimulation in the sense of, "We're going to make visual readers of all the children." That is ridiculous! Some children with fairly good visual capacities may find it much simpler and more efficient for them in the learning process to read braille. That is fine, but it doesn't mean they can't read a great many other things through the visual sense with magnification, etc., after their perceptual development has been stabilized.

ATTITUDES AND PSYCHOLOGICAL FACTORS -- BASIC PRINCIPLES OF TRAINING ACTIVITIES

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Let us spend a little time thinking about and discussing the affective aspects of how the low vision child feels about himself. Where does he get the attitude of himself? Where do the parents get the attitudes that they have about this child and what he can or cannot do? Very probably, they were told at birth, "Your child is blind." What does that mean to most people and from what frame of reference are they given this knowledge? Most likely, the frame of reference is a legal definition, 20/200 or less. This is the frame of reference from which the ophthalmologist, and many times the pediatrician, makes the diagnosis and communicates to the parents. Most parents accept this medical person as one who knows, and therefore, since he said the child is blind, it is accepted, frequently without question. Only if parents discover that the child does respond to light, only if they begin to discover that he sees as he directs himself motorically through the sense of vision, do they then begin to question. Someone may give a qualification, "Yes, but it is not enough to help him very much. He is still considered blind." This becomes incorporated into the parents' thinking about the child.

What happens to a young low vision child who has an impairment of his visual sense? The parents have accepted that he does not see so he is not given certain direction in his learning. He does not have toys and things used with him to help him start his visual development. More importantly, he cannot monitor the person caring for him visually nor begin to imitate and respond to that person. Much of parental stimulation is dependent upon the response of the infant. The child who does not respond does not reinforce the parents by satisfying them, so stimulation may not be continued. Attitudes, the image of how the child sees himself and how the parents see him, really depend upon this whole response and stimulation interaction process. Too often, little is contributed to the child's visual learning or to his visual development of even being aware that he can see some things. No attempt is made to stimulate him visually.

The second factor is a very potent one -- psychological attitude. Research tells us that lack of knowledge about blindness or low vision conjures in the mind unrealistic ideas about what one cannot do rather than what one might be able to do or can do. Studies have shown that adults when asked what kind of impairment they would least like to be associated with answer with blindness or anything having to do with visual impairment. This is from a frame of reference of people who have already learned, and they don't want something taken away from them that they have had and used in terms of learning. This attitude and what it communicates to parents is, "The worst thing that can happen is for my child to have a visual impairment." We live in a visual world and we think as adults from our frame of reference about all the beautiful things available to us.

A child becomes what others see him as capable of becoming. A child begins to function in a manner in which others see him as capable of functioning. This leads us to ask the question, "If we do not emphasize what the child does not have or can not do, but rather focus upon his ability to do what he can, to use what he has in the way that it works for him, and with the freedom to do it in the way that it gives him information, might we not be able to give this child a different attitude of himself?" He is going to need help in terms of clarification of what he is seeing. He is going to need language and discussion for clarification. We have to be with him because it is only through his curiosity, questions, and our accurate answers - the clarifying answers to his questions - that he is able to gain information, to put it together for himself. When does the child begin to ask questions? When he has an accumulation of information, exposure to environment and to things about which to ask questions. Children with very little visual ability may not ask questions because they do not have anything available to them from which to ask. Parents cannot be dependent upon their asking questions to determine what the child is able to see visually.

The way teachers see the child is crucial. We need to have an open attitude, to say, "I don't know if this child really moves around using his vision as a guide," or "I will make the assumption that he can learn or gain information, and I will not focus on how little he sees, but on his possible potential for seeing." Such an attitude gives the child a different perception of himself. Children really started me on this concern, these intangible factors we have never been able to put

together. Children would come to me in school at junior high level saying, "You'll let me learn to read; you'll help me learn to read; you'll let me look at pictures in your room, won't you?", which indicated a starvation to be able to use what they knew they had, to do what no one else had seen them as capable of doing. Children have a marvelous capacity for using what they have to the optimal if we create the situation, provide them with the opportunities, the materials and the experiences, and answer their questions honestly. With many low vision children, we have failed to provide the guidance, the stimulation, and the direction for them to use what vision they have for learning.

We can expect children to cover the full range of motivational characteristics. Some of them will have a great desire to learn and to do things while some of them will not. Some of them will be willing to work in order to learn to do and use what they have, while some of them will not. These factors are related to how far or how much visual development one can expect. If the child is afraid that the teacher is going to give him more work if he shows that he can learn to see a little bit, the teacher has a problem to work on. If he doesn't really want to see himself in a different way, or if he is afraid to see himself in a different way because he may lose some control of the way he manipulates his environment, one has another problem.

No matter how much we understand about visual development or visual perceptual development, we must be cognizant of the fact that every child has a different potential for development and differs as to how far he will be able to go in developing his visual perceptual ability. It is not related to his acuity or how much he is actually going to see. If we are not interested in something, we do not bother about visually perceiving and understanding. Children have this same kind of interest, or lack of interest. We cannot provide any visual development until the child first wants to learn to be able to see. We have to stimulate the desire within him and get him to really want to be able to do this. No amount of trying to get him to do something he doesn't really want to do will bring him to a very high degree of visual efficiency. Teachers must be willing to let children progress slowly, in order to bring them to higher levels of visual perceptual development. It does take time. We have to establish long range goals. The achievement of these goals may be attained at a higher level of efficiency if we move a little more slowly.

Teachers have to make decisions. Their decisions motivate the child in terms of how he feels about himself and how they feel about him. The commitment on the part of the teacher to some position in terms of learning for the child, especially in relation to the visual learning, is a big factor in how well the children are going to do.

There are psychological factors associated with the philosophy of the school system, whether one is in a public school system or a residential school system. There are educational settings where one can find a child with a paper sack over his head or a blindfold over his eyes so he won't look at the braille which he is reading. That is unfortunate. A long time ago we learned that any child who can read braille with his eyes can read some kind of print. There is nothing more difficult than to visually receive and decode, which is necessary when braille is read visually. Dr. Nolan's latest studies show us that decoding and processing a code as complex as the braille code requires the highest order of perceptual, cognitive skill.

The philosophy of one's system as to who is to make decisions about children is critical. If a teacher asks his specialist such questions as, "What should I do with this child in school?", that teacher is asking someone to make a decision, an educational decision, who is not qualified to do so. No one should make a decision about a child with low vision in 15 minutes or in 30 minutes by any kind of observation or examination.

How much do we yield to parental interference and parental pressure? How well can we communicate philosophy and commitment and explain what we are doing with the child if we think it is contrary to what the parents want? The first time the child goes home, the parents want to know if he has learned braille. When a child is labeled as visually handicapped, everybody thinks he is going to learn braille or has learned braille. Miss Henderson tells a very sweet story about a child who says, "No," when asked if he has learned braille. The parent says, "You haven't? Why haven't you?" The child says, "I don't know." When he returns to school, he asks, "Miss Henderson, when am I going to learn braille?" She laughs, sits him down beside her and says, "Here, let's start your reading lesson, maybe you'll decide for yourself." He is reading a second or third level book, and he says, "Oh, is that what my mother meant when she asked me if I'd learned braille yet?"

We have to deal with this parental attitude and lack of knowledge, plus our own commitment and possible lack of knowledge, and with our own philosophy about children and

and how children learn. These then are the psychological factors that will be the prime determinants of how successful the child will be in his visual perceptual development.

Question: Are there parents who are so neurotic that they don't want their child to see; they want the child to be dependent upon them?

Response: Yes, there were such parents in the first study. These parents insisted adamantly that the child be removed from the "learning to see" activities. They were both totally blind. This was an adopted child, and they were so threatened by the child's learning and her apparent ability that they couldn't stand it. They first put it under the guise that it was making her very nervous, and finally they just tripped themselves up by saying, "Well, she's just getting too smart and we're afraid she'll get out of hand."

Question: If a child is losing his vision, does one still teach him to learn to see all he can?

Response: I would go back to the philosophy about learning. Regardless of the child's prognosis, all the visual learning, visual memories, visual images that he can store in the brain are going to enhance his learning and his frame of reference for dealing with the world and himself in the future.

Question: How do children feel about struggling with print and then having to go to braille? **

Response: A teacher had read print until she was in the eighth grade and had to go into braille because she was losing her vision. I asked her, when I was trying to get people to understand why I was working with these children, if she had ever regretted doing all that print reading. She said, "No, I would do it all over, because I remember all the visual experiences that I got." She told me to go on and do the same thing, even though we knew the child would be totally blind in 15 or 20 years.

Question: What about large type books?

Response: It is possible to get the same effect with a magnifying glass and small type. Dr. Fonda says that one of the biggest mistakes we have ever made is keeping children on large type books long beyond the time when they need them. Any child who can function visually in terms of

** Response by Ruth Holmes.

learning and reading should function that way as long as he can. When he finds he can no longer function, he needs assistance, guidance, counseling, and a slow transition process to show how he can begin to function effectively with other materials and media. The child has to make the decision. We found this with many, many blinded teenagers and adults. They do not learn to read through the medium of braille until they have a need for it and really want to.

Question: This brings to mind a girl who was going blind. She was reading print at a very appropriate level. However, she couldn't keep up with the speed of the other children. She was put in a slow group and was bored. We made the decision to use braille. In six months or so, she had caught up with her regular classmates.

Response: Each child is an individual and it will depend upon his mental capacity and motivation. We do many of the same instructional and organizational type skills in developing reading ability with all children, regardless of medium.

Question: Are we going to stop using terms like braille children and partially seeing children in state legislation?

Response: Hopefully. We have thrown out both of those terms. The terminology is "visually handicapped," which means any person who has an impairment in his visual sense to the extent that it interferes with his learning in the same manner as other children. When we discarded the acuity idea in terms of educational implications, we discarded the old terminology.

Question: Do you mean you don't use the 20/200 for eligibility?

Response: That is medical and legal in terms of legislation. Some states have no acuity and legal definitions of eligibility. It is not an easy thing for school programs, since we use the legal classification and requirement for a child's eligibility for materials from the Printing House. That will have to go through Congress and will require a change in law. Work has begun on this, so I think this will come in time.

Question: How did this project come about?

Response: This whole idea and project came about because of a concern that the research had not reached the teachers. Those of us who work with visually handicapped children are

a fairly small group of people in terms of numbers in the field of special education. We do a rather good job of communicating with one another. We are also seen as the most committed group in the field. There is less turnover among teachers of visually handicapped children than any of the other special education programs. The decision was made to start with teachers and with issues that people seemed to be concerned about. We had some research, some replications, and very good evidence in the area of low vision. The idea was to develop a model or prototype which would give us a manner or means by which we could bridge the gap between research and teachers. The Printing House will make available a kit which will be called Utilization of Low Vision Kit. This kit will contain a Teacher's Guide for the development of visual learning abilities and the utilization of low vision. It will contain a Visual Efficiency Scale, a record sheet, and suggestions of things for teachers to use to assess the child and develop a profile of his visual performance. The assessment scale will also be available separately, but there will be one in the kit. A teacher can order as many kits as are needed for his school, and can also order separately the Visual Efficiency Scale in the numbers needed for the children.

ASSESSMENT OF VISUAL FUNCTIONING LEVEL AND DEVELOPMENT OF PRESCRIPTIVE MODELS FOR ACTIVITIES WITH LOW VISION CHILDREN

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Any child who has visual potential which could be described as light perception, motion-object perception or more should be assessed to determine his level of efficiency. The decision was made by the Coordinating Committee that the program should involve a visual efficiency scale. It is not a test and should not be referred to as a test. "Test" usually connotes performance in a certain manner. The decision was reached to call this instrument a "scale" because it identified performance in functioning with no expectations at a particular level.

Visual Efficiency Scale

(Note: In the following sections, the speaker is making reference to the Visual Efficiency Scale available from the American Printing House for the Blind, Louisville, Kentucky. Participants viewed a copy of the Scale as Dr. Barraga made the presentation.)

Children have a tendency to look in a fixed manner which precludes their looking all the way across the page. When administering the Scale, the teacher should encourage the child to move the paper or to move his head, whichever is most comfortable to him -- to look all the way across the line. Sometimes pointing with the finger or pencil will get the child to trail and look. It is necessary to observe how well the child can track horizontally. Observe how he looks at the items themselves. Does he have to look around them? Can he see the total form? What is his approach? Does he look in a circular fashion? Does he just guess? The child will try to do what the teacher wants him to do. One must watch for the possibility of indiscriminate choice, marking anything. Some children will pretend they can see and will mark everything, the first one, the last one, or something of this sort.

The teacher should listen very carefully to the kinds of remarks the child makes. What kind of verbal reaction

does he have? What kinds of questions does he ask? This can tell a lot about what the child may or may not be able to see.

Observe how well the child knows how to hold a pencil and to direct it to what he means to be marking. Sometimes it is necessary to encourage children to put their finger on the choice they want and then mark beside their finger if they are not accustomed to marking or if their visual motor ability is not synchronized so that they can mark what they intend to. You may have to direct the child or ask him, "Is it this one or is it this one that you want to mark?" These are not violations of instructions but simply good judgment by teachers.

We should observe the children as to whether they are tense or anxious. Do they seem relaxed? Do they show any indication of enjoyment at seeing things and making choices?

Another very important to observe is sensitivity to the lighting in the room. The child may need to be placed at different spots in the room -- nearer the window, for example. There may be a need to adjust the lighting in some way. Sometimes it is effective to close the blinds or to use a tenser light and direct it right onto the page so that there is no reflection back into the face.

The teacher should make notes. Notes will provide insight about the potentials of the child and give direction as a prescription is worked out. Note areas in which you want to work more closely in the future. It is rather difficult to remember such things, especially if you are working with a number of children. Note the attitude. Sometimes this will indicate how much encouragement and motivation will have to be provided externally. Sometimes the attitude will also tell how you may have to restrict, hold back, and plan more carefully for the child you have motivated so highly.

The items of the Scale start with form discrimination. Section 1, the first 12 items, is primarily the discrimination of geometric form, object contour, light-dark intensity, and size-position. There is a progression from the easiest kind of form discrimination to that which could be a little confusing, from geometric form to object contour. Item 4 is a recognition item. The child is asked to mark the cross, which means that we observe if he can perceive as well as recognize the differences in forms. A transitional item, 9, notes the density and

placement of partial form and partial outline. It might be a little traumatic to take away all form and move in immediately with an outline. As the objects move completely to outline, circles are chosen since that is the simplest thing to follow when one has only an outline. Two items, 10 and 11, involve discrimination. The second is a much finer discrimination in terms of decision making. Many children are unable to make this discrimination. The succeeding item, 12, asks the child to note size difference in openings and the position of the opening, carrying through the positioning in space, but introducing a second element.

In Section 2, the first items are less complex but smaller. The differentiation in space remains the same. As the items become smaller, full form is used rather than outline only. Item 15 introduces inner details for the first time. Next, very complex external shapes are introduced. Such items as 16 and 17 require very precise discrimination, and many children are not able to do such an item. Children who are able to do them show a high level of discrimination skill. The progression of items is to a complex abstract item, and item 17 requires visual and highly perceptually oriented skills. Item 18 provides information as to how well the child can track horizontally. Abstract details in objects and figures are introduced next. We observe if the child can note line differences and follow horizontally.

Section 2 presents the very simplest kind of visual closure or object constancy. Item 22 requires the child to put together two essential pieces so that they will look like the completed object. The differences are not very great. A lot of children are not meticulous in working with discrimination cues. They do not note the differences -- that one handle is longer or that there isn't a little point on the hatchet top. A second closure item, 23, becomes a little more complex. Reading research has found that one of the major factors differentiating ability to learn to read is this ability to close visually and to maintain object constancy. In item 24, the person receives only a portion of material and must put it together. If he has a mental image of the object that is strong enough that he can pick it out when he gets only a portion of it, he has developed visual closure. The grill on the radiator provides what Gibson calls the one distinctive clue which a person can hold onto.

Section 3 continues with visual closure, but at a much higher level, progressing to a very sophisticated and abstract item. These items may not be visually difficult. The child must perceive the task and understand what he is to put together.

Items 27-30 relate to spatial perspective, a continuation of object constancy. Does an object maintain its constancy regardless of the position? Does the child confuse one object with another if both are placed in a different perspective? Finally, can the child put two things together in the relationship of spatial perspective and match them to a similar composition?

Item 31 introduces objects and begins by matching exact objects. In item 32, the child must be able to separate figure-ground and choose an object that is in the same position. This is not an easy item if the child has not had the experience of looking at pictures.

Items 33 and 34 present hidden figures in abstract designs. Children may have difficulty in these two items. Much of this is related to practice and has a relationship to speed of reading.

Item 35 is a very complex visual discrimination item which requires the child to match distance. Item 36 introduces symbolic material, introducing the form rather than the outline. The letters which are to be matched are different in their form to see if the child can maintain object constancy. The child need not recognize a specific letter, but needs only to find the letter that is the same.

Section 4 is comprised of items employing letter and word symbols. Item 37 introduces manuscript style in which the child matches the letters. The size is 18 point type. You will note that it is singular, since it is much easier to match single letters than those in sequence. Item 38 presents letters in sequence. Item 39 presents a reversal factor which can be related either to carelessness in terms of visual discrimination or to a perceptual factor. In the symbolic progression, items move to matching words that are very similar. How much of a stimulus does a child have to have before he can recognize it as a particular word? In item 42, the stimulus is presented in whole, but choices are only partial. This is a rather complex task.

The final items take into consideration size, position, sequence, relationship of letters, letter groups, and words. Item 43 relates to configuration. Does the child have a mental image of the configuration of a word? If so, he can choose the word that will fit into the box. If children can get a mental picture of the configuration of a word, it may be a great help to them in learning to read. Type size is reduced and varies in items 44-48. Items 44 and 45 require precision in noting reversals and sequence.

Item 46 determines if the child can look internally at words, pick out a group of letters, and find that sequence of letters in one of the longer words. Item 47 introduces cursive style. I think you will enjoy one child's reaction. She had done beautifully and had gotten virtually every item perfect. When she got here, she stopped and said, "I can't read cursive." There is no reading to any of this. The task is to see which of these groups of words looks the most like the stimulus group.

Question: Has the Scale been field tested?

Response: Not at this time, but we hope to. At this point, we have not had the time. We hope to field test the Scale and to gather more data.

Question: Suppose a child could not do any items.

Response: We might need to go much farther back, work with the child and establish a rapport. He may need to establish a knowledge of his body orientation in relation to the environment. The primary purpose of the Scale is to give some indication of the child's readiness and possible potential for visual learning. We analyzed items on the original with 3, 4, and 5 year olds, normal kindergarten children. All ages of low vision children up to those who had acuity measurements of 10/200 were tested. We went through items very carefully to determine what was difficult, either visually, discriminatively or perceptually. Too many low vision children performed at much too high a level. We had to look at academic learning experiences and perceptual factors required of children in visual learning. That was the reason for working in perceptually oriented items at a much earlier level. We found this really happens in visual learning experiences in the classroom. If the child cannot move around perceptually with his visual abilities, he isn't ready for visual learning experiences.

Question: What if the child doesn't understand what he sees?

Response: Move back to a lower level of concrete objects and language. Such behavior says to you that the child is not ready for any kind of symbolic, representative material until he has had more concrete experience and language development. Perhaps we need to change our way of thinking about the kinds of children with whom many of us work today. Children who are slow in developing need many more environmental kinds of experiences, more tactual discrimination experiences, and visual discrimination experiences with actual material before they can use symbolic representation.

One of the biggest things that will present your biggest challenge is how to assess children's behavior. If children cannot respond to something such as the Scale, that is the best clue in the world. That child needs only concrete kinds of experiences. Any child with low vision (or good vision for that matter) who has sat in a chair in front of some kind of auditory input or who has been kept in a crib or who has been restricted in a playpen, or who has had no verbal interaction with adults for language development and clarification has really not had a wide variety of experiences. Only language enables us to make use of and to see and understand the experiences we have. One of the things found in some of the research is that some children reach the recognition and labeling level in terms of certain things they are able to see, but they do not know how to make discrimination and accept cues. We have to be very careful in terms of moving children too fast. Most of the people writing in the field of perception and cognition feel that verbalization does not contribute to actual learning.

Question: Do you go through the Scale all at once?

Response: The teacher has to use her own judgment. We suggest that you might want to stop at the end of Section 1 at the first sitting. There are four sections and you may do only one section at a time. The items are ordered in such a way that they become more complex visually and perceptually in each section. It is very unlikely that children would perform very well in the early items in the section, be unable to see others, and then function well in the rest of the section. They might perform rather well on the more easily perceived and visually discriminative items in all sections. Any child who could perform on every item in the Scale should already be a visually performing child in the classroom because he has all the readiness needed to perform exclusively through the visual sense.

Question: Would you present only one line at a time?

Response: Yes, this is suggested in the general instructions. You may want to have a cover sheet with only one line showing. If necessary, simply expose one item at a time. This will take a very long time but if the child is motivated and you feel he has some potential, it might be worth the time to work with him in that way. These are the kinds of things about which only you can make the decision as you work with individual children. Hopefully, the instructions are written so that they have enough flexibility, freedom and suggestions for teachers to use their own best judgment.

Question: Has this Scale been used on perceptually handicapped children?

Response: Many children are thought to have visual perceptual problems. I use the term advisedly because studies show that there are no common characteristics among children who are labeled as having visual perceptual problems. Many of the children simply have not had language development or anything to clarify their visual experiences. Others do, in fact, have problems due to various reasons. No attempt has been made to use the Scale with children classified as perceptually handicapped.

Question: Are there any special materials to use with such children?

Response: There are a number of materials available. Some of those which we use in vision training were really developed to strengthen and to ready children perspectually. Visually handicapped children may also have learning difficulty kinds of problems. I think you will be able to tell a child who simply has a visual impairment and a very intact, well-functioning brain. The only way to tell the difference is to try the child with other toys and materials and see how he processes and encodes through auditory and tactual material.

Profile

At the right, the profile form lists visual skills and behaviors in broad categories. Corresponding items in the Scale are represented by number at the left. The items are ordered in each section, sequenced by the difficulty of an item. The intervals for ordering are: Low, Marginal, and Satisfactory Efficiency. Circle the items on which the child is successful. Draw a circle of performance.

Analyze the child's performance. Look at individual strengths and weaknesses. You will be able to see the range of tasks and the level of difficulty. The child may be able to discriminate and understand form, outlines, objects, and symbols, but may have very limited efficiency, and overall, a rather low performance. The program you plan for individual children may need to cover the entire sequence, with less emphasis on some kinds of activities than on others. Studying the profile of performance will indicate the focus you should specifically give to certain kinds of activities. A child may be able to see forms but be unable to tell the difference between them or to match two identical ones. This is a perceptual factor in understanding and interpretation of what he is to do. If he has never been directed in visual activities, he

may not be able to understand the terminology of "the difference between two things." If you find that a child can see things but does not know how to note the differences between them, you know that he is functioning at a very low level of efficiency. You should give him an opportunity to look at a wide variety of visual forms to learn each distinctive cue -- corners, points and curves, so he can differentiate one from the other.

Let me show you now the actual profile of a child, Case 1. (Note: the profiles referred to appear in Teacher's Guide for Development of Visual Learning Abilities and Utilization of Low Vision.) In Section 1, he was able to get the items that discriminated between forms, Items 1, 2, and 3. He could not recognize one from the other on Item 4. He was not able to make the distinction in the object contours, but he did perform on the light and dark density factors and was able to pick up the factors when he saw the form again. He could perform on the size factor if there were good differences between sizes, but when it became more discrete, he could not make these kinds of distinctions. In Section 2, he did some position in space items, but at a very low level. He could not perform on the items that indicate marginal or satisfactory efficiency. He was able to do very simple visual closure, and he was able to discriminate the very large abstract details. His profile suggests that this child may be able to see large things, but that as the things become smaller he has a little difficulty. He is even able to perform on some of the letters presented singly and make the discriminations. When they were presented in sequence, he was not able to do the items. As you view the complete profile, you find that this child has a fairly low level of efficiency.

It would be best to start with concrete things for him to work with. Then integrate representative materials on paper and spend a lot of time bringing him up in the skills where he has great gaps. From the point of object closure and object and abstract forms, it will be necessary to go through the entire sequence with him because his efficiency is so minimal that it could be by chance.

In the profile of another child, Case 2, there is a marginal degree of efficiency to Section 4 where it becomes a little less than that. Perhaps this child has never had an opportunity to be exposed to abstract symbology in the form of letters and words. Perhaps he has never had books to look at or anyone to tell him the distinction between the letters. He sees them well. He

needs an opportunity to learn through the things he has been exposed to visually. We can start the task with matching concrete forms with representations of the form. See how quickly he moves. Be guided by the efficiency of the child. If he performs well, there is no point in spending time. Move him to a much higher level immediately.

Here is another profile, Case 3. The girl is 14 years old, one of a set of twins. These youngsters are very bright. Due to a variety of circumstances, they have not been stimulated and challenged anywhere near their capacity, so we are working with them in a demonstration program this summer. The two girls are grouped with another 14 year old who is very highly motivated and very interested in learning to perform visually. We hope that in four or five weeks they will develop a higher degree of efficiency and greater internal motivation. They will spend a great deal of time in visual kinds of academic learning which will challenge them a great deal. Our subject has never been required to look at minute details or to make interpretations in relation to the material. It is evident from her performance that she picked up a lot on her own. The performance indicates that she has been exposed primarily to symbology and abstract kinds of reading materials rather than having had discrete kinds of discriminatory cues taught to her. With a child like this, I would go back and play all kinds of games to make very fine discriminations. When there is improvement in this area, reading should become easier. She will be a lot more efficient in terms of reading speed if she has this preparation in making specific discriminatory cues.

Some of you are familiar with writing an individual prescription based on a child's performance in relation to skills. This is being emphasized in Special Education -- the prescriptive teaching concept. Because of the complexity of special children, we cannot work with them in a group - each child doing the same thing. This is especially so with visually handicapped children. There are learning problems, evidences of emotional imbalance and instability, and perceptually oriented problems in addition to the visual impairment. Such conditions account for the trend toward prescriptive teaching models.

From the profile you should be able to say, "Ha, this is what this child needs." As you relate functioning to particular items on the Scale, you will also have a total list of behaviors which identify the item and a description of the visual behavior that is required. When you pinpoint an item the child is not able to perform, you will also know the kind of visual behavioral skill required. You have the clues of what to start with and what to support.

Activities and Materials for Visual Development

Before the teacher presents materials for vision training, she must assess how well the child uses his eye muscles. Some children do not know how to control them so it may be necessary to use a variety of activities to stimulate control of eye muscles. Observe how well the child can track, follow from left to right or up and down. Use whatever is available and consider the importance of motivation, reinforcement, support, etc.

These are specific things that you can do, such as using pen lights or something of this sort. Put the child in a semi-darkened room so that he has to follow a line of light. He can learn to track in this manner. Make marks with Marks-a-Lot pens and observe how the child responds to the marks. Feel for the level at which he is presently functioning. Watch how close he has to get to tell you that he can see something. Pick out or make a large dot and ask the child to trace around it with a pen. His performance indicates whether he has some abilities in visual motor coordination.

We have had a very interesting experience this summer in working with a young woman with cerebral palsy. She has very mild involvement as far as her motoric abilities are concerned. She walks well and does gross activities very well. She apparently has very limited fine motor coordinations and skills. She was classified as blind. The parents began to notice that she seemed to see some things. No effort had ever been made to determine what she could see. She had some tactual agnosia, as suggested by a neurologist. It certainly appears to be valid because we have been able to do nothing to stimulate her tactual sensitivity or discrimination ability. About four weeks ago, we started focusing on visual stimulation. We made another discovery -- that she had a very serious lateral imbalance in the muscular systems in her two eyes. They do not coordinate or function well together. We are trying a different approach and presenting everything to her on one side. She is virtually forced to use the eye with which she can coordinate most effectively what she does with her hands. She immediately began to trace around things we gave her. Now she is writing her own name. She has had no more than an hour of various kinds of visually stimulating activities. We have four more weeks and in that time hope to have her well on the way to visual learning. It had been accepted by definition that the girl was blind so no one had ever tried any kind of visual learning with her.

When vision training begins observe what the child can do. This will give you a cue as to where to start with him. Be very careful not to force something on children. Fatigue is an end product of lack of interest, boredom, fear or other things. Fatigue, in relation to body parts, is also a factor when the child has to work too hard to control muscles of the eye by focusing and tracking. Let us not make the mistake of asking the child to do too much at one time. Start very gradually, perhaps working only five or ten minutes. Follow with a relaxing activity. Some children will have a great deal of fatigue in the beginning and others will experience fatigue in time. It is important for us to be sensitive to such factors as we are getting started with children and preparing them for a program in vision training.

A third factor is to start with materials with which one knows the child will be successful, perhaps very low level materials. Be sure they are large enough that the child can see them without too much effort, and that he is given choices as to size. Some children will say almost immediately, "I can see the smaller one better." And they can so give them that choice.

The Teacher's Guide for Development of Visual Learning Abilities and Utilization of Low Vision presents seventeen objectives of a vision training program. No objective is intended as a lesson or as an objective for a lesson. They are behavioral objectives which may cover one, two or three weeks. Each may cover one lesson, five lessons or ten lessons, depending on the child's needs.

Visual training starts with visually looking at forms that have a three dimensional quality. Let the child look at the forms, learn size relationship, learn length relationships, place them in descending and ascending order, place all those of the same height together, and do all the other kinds of things that a child can do with materials of this sort. Specific materials are not needed, only concrete objects with the characteristics mentioned.

The question arises as to whether we should use color or black and white. Some interesting evidence suggests to us that many children are able to see good color contrasts, such as strong green on yellow or strong blue on white or yellow much better than they see black and white. Colors give contour. We have discovered that low vision children see things on color television with great sharpness and clarity that they could never see on black and white. This is because of the three dimensional aspects of color which

make a difference in contrast. Uses of color depend on the child. Some children will be color blind so it will be a problem to use color with them. Some of you may be concerned about the things you have read of the danger of sitting close to color television. Dr. Fonda was asked about this. He feels that the low vision child does not get close enough to receive the amount of rays that might be detrimental.

When we talk about color with children, we frequently do not let them experience all the various intensities and shades of color. We probably teach them only the six basic colors. We talk about red, and suddenly we begin to talk about pink. Pink is a color but we have not taught that it is a shade of red and how it is derived. Provide activities in which the child fits shades and hues into a color class. Observe how intense the shade must be before the child sees it as a specific color. Many of the low vision children will see light blues as white because the blue does not have enough color for the child to put it into the blue category. Many children will see dark green as either brown or black. Those very dark colors all seem to give the same kind of information. There is not enough contrast.

There are a variety of geometric forms in color that may be used with children. You may need to move very slowly. Teach the child language, as well as shape. The child has to learn points, slants, roundedness, corners, and the names of these things and how to differentiate between what they are. How does a sphere differ from a pyramid? The child needs the language, as well as the visual and tactual recognition ability of how to differentiate these shapes.

From three dimensional, the child moves to two dimensional shapes. He must get a perspective of round shapes which look one way when they have height and another way when they have less height. All the things the child has seen previously in the form enable him to visually find forms and match them to others.

It is necessary to present one thing from many different perspectives in order to teach spatial position and orientation. Provide the child with a shape that is consistent, such as a triangle, but presented so that it does not look the same in any of several positions. The low vision child has to see such things so that he will be able to develop memory of how objects look in various positions. Piaget talks about the accommodation of

assimilation process. If the child has a constant concept, something that he really understands and can think about, he can be given something that is a little different or has added information. If it has some of the same qualities, he can make the accommodation for it. When he understands it in relation to other things and to the general category of things, he has assimilated it into his understanding and his thinking. This is what we are really striving for in moving in very, very small increments through the perceptual development.

Question: Have you found in working with the children that they tend to go back and feel things, as well as look at them?

Response: If the child needs the support of continuing to do it tactually, the teacher has to use his own judgment as to how to proceed. Perhaps he can make it into a game, "Let's put your hands behind your back, and see if you can tell the difference." The child doesn't understand what fun it could be to learn to see something. Maybe we need to let other children involve him in the process rather than our trying to teach him. Children get into habits and need to be reminded that they are going to try to see it instead of touching or feeling. Perhaps the teacher should introduce visual activities as a game, certainly without pressure.

Think how easily visual stimulation kinds of learning can be incorporated into regular teaching. This would be a more desirable philosophy than simply focusing on visual stimulation. Help the child get the idea that once he has seen it, experienced it, handled and worked with it in its actual form, he can put it on a piece of paper in two dimensional form. A symbol on a piece of paper is representative of something that he knows about. That is the step children take when they move to representative forms.

Some children will not need all the steps in every kind of learning experience, some will. The teacher can provide considerable range and variety as she makes selections of the kinds of activities that children can perform. Following activities involving two dimensional and representative forms, outline shapes are introduced. There is a game, chrominos, which can be played to help the child understand shape and outline. Materials from the Fairbanks-Robinson program have forms and tracing sheets. These can also be very helpful, especially in developing the visual motor fields and the ability to make marks. Can the child make this transition from the total form when he has only the outline shape? He can begin by drawing shapes and matching forms to outlines.

When there is evidence of competency in the sequence presented to this point, puzzles are introduced. Puzzles provide the child with an opportunity to develop visual images of forms and shapes by assembling and integrating. The child can begin by drawing shapes and matching forms to outlines. He may use pictures and guides to build shapes and designs. Materials are being developed for pre-school education by the Instruction Materials Center of the American Printing House for the Blind. An adaptation of parquetry design has been developed with an inset board so the handicapped child can handle the blocks better. The child with poor vision may not be able to place and retain the blocks in very good form if visual motor development is also poor. The board has depressions into which the blocks fit.

The real challenge with puzzles is when the child can put the pieces together without seeing a picture. What does that mean? "I have the mental image in my brain of what that should look like and with the pieces I can build it myself." When the child demonstrates this competency, one knows that he is developing visual images.

Now the child should be ready to make the transition from form, geometric form, to objects in the environment. Association Cards relate objects that the child knows to geometric shapes. It is a very short step to take in making this transition. Let the child pick out all the things that look like a rectangle, like a square or like a circle. There are wheels, balls, buttons, etc.

Pictures present a new class of object forms, or form representation. Familiar articles of clothing are good to start with. Hold up a sweater and let the child get a visual image of it. Next, present a picture of a sweater. Use other common things that children know about -- animals, toys, etc. Use actual articles or models to match with pictures for reinforcement. Reduce the size of the pictures. How small can the picture be with the child still able to make the discrimination and recognize the object? Once the child has the visual image it belongs to him. He knows it and recognizes it whether it is a piece of clothing or a word. We must build into the learning process gradually, reducing to the smallest possible size that can still be seen. Give the child support as his brain, rather than his vision, takes over and does the work.

Another objective of vision training is to make the discrimination between inner details. The "Match-Me-Game"

requires discreet detail discrimination. Eventually the child must learn to separate figure and ground. He must also be able to pick out what is missing, the unssen part of a house, for example.

The child needs to be able to pick out the dominant object in a puzzle or a picture. Can he find, for instance, houses in the background and recognize these as a distance perspective? It is very difficult for low vision children to get the perspective of distance in a picture. If he can pick out the fence wire in the background, he has very good discriminative ability.

Provide pictures for story telling. Let the child put several together so they tell a story. A commercially produced game, "See-Quees", is fine for this purpose. Some of the sequence depicts action which requires very close visual discrimination and at a high level perceptually.

Let me suggest to you that many children really do not know how to look at a picture and tell a story in sequence. The ability to see the sequence of events and possessing the language to describe the action which is seen, have a very strong relationship to reading ability. If the child is not able to comprehend and interpret what he may be able to see, his overall comprehension may be reduced. If we focus only on word attack skills, we are not teaching comprehension. The second level in reading is understanding. It is suggested that unless the child can develop a mental picture of the action about which he is reading, he will not have a full understanding and comprehension of reading material. The secret is to integrate these two particular skills and not to focus on one to the exclusion of the other -- not to focus on the development of one and ignore the development of the other for too long a period of time. There is purpose in beginning with the skill of recognition; then very slowly the material takes on a form which requires understanding and interpretation. The discrimination and recognition skill of the symbology must precede the introduction of low level kinds of interpretation and understanding. We start with very simple kinds of things that do not require a lot of understanding but we know that the child has a visual image of it.

Children learn to associate words with familiar objects. They may have only one image of an object, such as a table. Low vision children have great difficulty when they learn the word table and are shown the picture of a table of another type or style. It is not like the table they saw before. That child with his low

vision does not have the opportunity to acquire incidentally, through exposure to the environment, the mental imagery of all varieties of tables. It is not like the table they saw before. That child with his low vision does not have the opportunity to acquire incidentally, through exposure to the environment, the mental imagery of all varieties of tables.

Many other similar activities and/or games can be developed by individuals in addition to or to replace those suggested. The needs and responses of the children are good indicators of the desirability of supplementary activities to be initiated by the teacher. Similarly, the materials suggested are not intended to be inclusive of all appropriate ones. Teacher-made or selected materials from magazines, books, or newspapers may be just as effective in producing the desired learning.

METHODS AND MATERIALS WITH LOW VISION CHILDREN

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I would like to review, for a moment, the purpose of our study together. We have endeavored to develop an understanding of the developmental nature of visual functioning, the procedures most valuable in fostering increased visual efficiency, and the range and type of materials most applicable in the visual stimulation process. Since kinds of materials, methods of presentation, and the attitude with which they are presented play a vital role in the visual development and growth toward maximum efficiency of use, let us take a brief look at how some of these materials and methods may be adapted to the sequential pattern of visual development and used in the sequence of activities.

The teacher should be aware that the child with low vision has missed entirely or perceived only in part the many visual experiences afforded the child with normal or near normal visual abilities. Observations made during the administration of the Visual Efficiency Scale and information provided by the profile sheet drawn from the results of the Scale direct the teacher to the greatest areas of deficiency or of need. This provides a point at which to begin and a direction for the individualized prescription. If observations indicate that the child was unsure or the effort was slow and laborious, a quick review of the very beginning of the sequence might allow further diagnosis or permit time and opportunity to discuss and experiment with other things such as lighting and magnification. Some past visual experiences may be evaluated and areas of interest tabulated. Many kinds of materials are beneficial in designing activities for these purposes as well as for carrying out the original diagnosis and beginning individualized vision training.

Before consideration is given to the materials, the teacher must be very familiar with the sequential pattern for learning to see -- so much so that it becomes a natural operation as the lesson or series of lessons for each individual student is planned.

Fixation is the first and primary part of the pattern. If vision is very low, there may have been little prior effort devoted to focusing on anything. One girl with

whom I have worked has eccentric vision with no macula or central point of focus. She could see if she happened to catch the object or view in passing. She did not know how to fixate. At the eighth grade level, she was becoming very curious about many things. She was often frustrated at her inability to find and look at some animal in the science laboratory, for instance. She was unable to locate an object on a desk and turned her head constantly in an effort to find the person to whom she was talking or an object in front of her. Holding fixation after the point had been established presented another problem. Many exercises of different types and with various approaches were tried in an effort to develop this ability. Some of these activities included placing a block or a tube on a flat surface, either black on light or light on black to maintain good contrast. The object had to be stationary and small enough to bring into focus at close range. Tactile exploration was allowed during the first session to develop the idea of how to scan with her eyes. A definite plan to scanning or looking was established. After that, the hands were in the lap and the scanning procedures with concentration on quickly finding the object, which might appear any place on the desk, established acceptable focal habits for this student.

It was found by experimentation that additional light was necessary. The Dazor lamp with magnifier on a floating arm to allow personal adjustment provided a good white light directly on the area of work. Any shadow tended to distract or confuse. As the ability to focus developed, the light adjustment was not as great a problem and the magnifier was found to be useful for outline and line exercises. Blackboard work may be useful in establishing gross patterns and movement, as well as being at eye level and reasonably easy to distinguish if the contrast between board and chalk is great enough and the light can be regulated. In the case cited, blackboard work did not prove successful.

A second part of the sequential pattern is following and tracking. In the case of the girl mentioned above, objects were moved and the student was required to follow the movements. The objects were transferred to paper in symbol form. Eventually, the objects for fixation were diminished to a heavy line made with a wide felt-tipped marker. The counting of lines on the page (2 to 4 in number) gave fixation practice. The lines were varied in length and the student was required to track across the page for each line. For a younger child, a reward at the end, running a car on a roadway, or walking a doll may accomplish the same purpose.

In the case cited, the student needed to learn to use eye and hand together as a more advanced exercise in fixation. She needed to be able to track or follow what she was drawing with a wide felt-tipped black marker. Up to this time, she could rather readily find the lines on the page or find an object and she could follow the line with her eyes. She could make a mark on the paper using the tactile method and then look at it. The problem was to focus on her hand and marker, a specific and finer point of focus and more difficult for her to accomplish. After several hours of hard, almost frustrating work, she called across the room where I was working momentarily with another student, "Mrs. Holmes, I can see where my pen is going! I found it!" I think that I was as elated as she. From that point progress was more rapid. The final goals for this girl could not be set too high. She had an experimental nature and tended to want to achieve more than ability would allow. She had to set honest goals and understand her particular problem so that she could function visually as well as possible and without excessive frustration. The cosmetic effect of the fixation and tracking exercises proved most beneficial. The turning of the head to find things diminished to occasional slight movements which were not distracting.

In addition to the light, chalkboard, adjustable desks, and geometric figures, a stock of colored construction paper and a number of different widths of felt-tipped markers and pens are a must in any basic materials list. An extra quantity of black construction paper is advisable. A set or two of stencil forms -- to make geometric and animal forms as well as other familiar forms in the gross dark shades or black -- is a basic start for exercises in likenesses and differences, classification, size, position and matching.

The materials just listed provide a fundamental part of the next step in the sequential pattern. Games of matching, identification, direction and the like may be used. The material and activity may be directed toward the age and experience of the student. Curiosity and the excitement of discovery usually furnish motivation to continue.

Drawing exercises, identification, basic geometric shape, line drawings or such things as stick pictures are the basic materials of the fourth part of the sequential pattern, which is outline. With the older child who is merely transfering knowledge of symbol from braille to print, this could include basic letter symbols.

Specific inner details of the simpler forms first studied evolve naturally as the next step. The ball may take on color and stripes or flowers and the cat may acquire eyes, nose, mouth, fur, and distinctive paw markings. These require a more advanced ability to discriminate. The last part of the sequential pattern follows logically -- integration into the whole. This becomes the ultimate goal. It may be integration of figure-ground or it may be perception of the whole object by scanning and combining the various parts as they are seen at close range. It may be integrating an object or person in its environment.

We have discussed the sequential pattern of learning to see. This includes fixation, following and tracking, realization of form and identification, outline, and specific details. The last step in this pattern is integration. It is necessary to integrate and make meaningful everything that the student has learned to do with his eyes no matter how limited his goals.

We should keep in mind that one progresses from large to small visual images, from gross to finer detail, and from simple to analytical and integrated images and activities. Let us examine some materials as they apply to the sequence of activities as designated by Dr. Barraga. This sequence is:

1. Noting likenesses and differences in classification, size, position, and specific details

2. Matching of forms and objects in one class, different classes with similar contour, and different classes with different contour

3. Ordering of objects in size and position sequences

4. Grouping and relating objects in terms of class, usage and similarity to other objects

5. Discriminating missing parts of objects, pictures and symbols with Gestalt pattern visible; then without the whole visible

6. Integrating parts of objects, pictures and symbols into meaningful wholes with and without patterns (puzzles)

7. Recognizing and labeling objects and symbols (letters, words, and numbers) as to category, function and specific name.

The materials may be concrete or three dimensional, representational or picture form, and abstract or symbol. They may be commercially prepared or commercial materials adapted to meet a particular need. If commercial materials do not seem to meet an immediate and highly individual need, the teacher may have to improvise upon some idea and develop material to meet that particular need. Often, these items can be adapted to a variety of exercises. Their flexibility and expandability allow the teacher to build upon the interests, experiences, knowledge, and abilities of the student. This may provide motivation and allows the student to obtain added enjoyment from the visual experience.

Activities for developing low vision must follow the sequential pattern, but may operate simultaneously so that variety can be an aspect of the lessons. For example, gross discrimination may include comparison of likenesses and differences of the inside tube of wrapping paper cut to various lengths. Another exercise for the older child might include painting these sets of tubes according to his own color selection. Such an activity tells the teacher much about the ability to discern color and coordinate colors. It also gives practice in eye-hand coordination and provides further discrimination when it is necessary to find any spots which have been missed. Size of materials may be reduced by use of the Montessori type wooden peg sets or wooden dowel rods cut to various lengths. Cuisenaire Rods afford a reduction in size for the same type of activity. Again, color concept and discrimination can be studied.

Geometric figures of various shapes, sizes and colors may be used or made. An example is parquetry. These may be studied for identification and for transfer to a representational copy. Lessons of increasing difficulty can be planned, matching the blocks to a directional or master sheet. Teacher-made flash cards of geometric shapes and insets are useful. Drawing the figure has value. Reproduction helps to develop a concept of the figure. Since there are examples of geometric figures everywhere, a field trip to discover these shapes allows the teacher an opportunity to observe the student in a spatial situation. The older child is usually anxious to read and write. The letters follow geometrical design, so what better place to begin!

Picture study begins with simple, solid color forms of such objects as animals, trees, and items of transportation. Many of my students who have been braille students with little or no visual stimulation do not recognize many of these. They enjoy learning and sometimes playing games

with each other. These forms allow for directional study. I have found that some of my students have great difficulty turning the object or animal so that it matches the direction of the one beside it. For additional practice, duplicated or ditto sheets with increasingly difficult identifications, comparisons or items to discriminate can be purchased commercially.

For development of the representational or picture study, inner detail in simple one-item pictures follows use of the basic silhouette. Pictures can be purchased or clipped from magazines and mounted. Students have great fun recognizing their favorite food, car, toothpaste, animal, or any other item of interest. The pictures can be developmental in nature, gradually adding more items and simple uncluttered backgrounds to the pictures presented. More active background, increased foreground and movement and/or perspective are more difficult to see and perceive. Developmental exercises from kits or duplicated sheets are effective. As the pictures increase in difficulty, a definite "pattern of looking" has to be taught. This varies according to the individual vision problem.

Let us look briefly at letter and word study. The relationship between the geometric figure and the letter is compared. With the older student, letter identification and learning to form the letter can be studied simultaneously. Board work is useful at this point to give the gross movement. Writing requires new kinds of movement to some of these students. As the transfer is made to paper, the letter form is more precise and the work seems easier. Picture and word study may be combined. Pictures may be identified with written names or sentences may be written about the picture. Pictures and writing are to be matched. Flash cards are used and basic reading is begun within the grade level of the child. Titles from headlines of leads in advertisements can be clipped and mounted. The print will vary in size and style. It is amazing how many styles of print are to be found in current publications. These samples can be "eye catching" slogans or a paragraph in an advertisement. Children will like copy exercises and the opportunity to read their own writing during some sessions. Use of picture and slogan combinations is fun for the child. Newspapers afford opportunities to plan shopping expeditions by looking for the sales. Planning a menu from the grocery advertisements can be entertaining and provides good word study. Catalogs, selected used greeting cards or Christmas cards offer interesting reading and various styles of print. These activities offer the opportunity to work with magnification and good lighting practice when needed.

Puzzle exercises are used early in vision training. The first puzzles may be made by dividing simple geometric figures. A part-whole relationship is established and finer discrimination is an integral aspect. The scanning abilities of the student may be established or reinforced in puzzle practices. Use of puzzles helps the student to integrate parts and finally recognize the object or picture he is using. Word puzzles are also useful activities.

I have given you a few ideas concerning materials and how they can be incorporated in a program of vision training. The budget may dictate that many items be teacher-made or adapted from materials already available. It is most helpful to search through dime stores, book stores, and craft shops for inexpensive items that will stimulate visual curiosity.

Storage may be a problem. It is helpful to arrange items in the cupboard or on the shelves in an order that follows the sequential pattern. If a teaching plan has to be changed or reinforced, it is simpler to select the materials needed. It might be a grand experience for individual students to explore the shelves or parts of them under your direction. If the student has enjoyed his visual experience, it is truly worthwhile.

ROLE OF THE TEACHER

Mrs. Ruth Holmes, Teacher
Illinois Braille and Sight Saving School
Jacksonville, Illinois

The opportunity has been provided during these two weeks to develop an understanding of the visual process, methods, materials, training techniques, and other related areas which are pertinent to stimulation of low vision. Such stimulation is necessary if the person with low vision is to function as efficiently as possible with that vision. You have had an opportunity to experiment with some of these ideas in a clinical situation. Hopefully, you have formulated some individual concepts and objectives for this diagnostic and perscriptive type of teaching.

It would seem logical at this point to discuss the role of the teacher where low vision stimulation is concerned. The first prerequisite to your role is an understanding of the developmental nature of visual functioning and the procedures used to foster increased visual efficiency, as well as the range and type of materials most applicable in the visual stimulation process.

Samuel Ashcroft once said, "Definition and diagnosis have made many handicaps." Classifying students one way or the other leads to certain treatment and, in turn, may cause other handicaps. According to a leading sociologist, we tend to specify what shall be called handicaps, seek to identify those who conform, seek access to them, and endeavor to change behavior to achieve what institutions believe are their potentialities. We then live up or down to this level. As Robert Scott said in The Making of Blind Men, "Agencies create people to serve." When considering the borderline child, we must be aware of this problem and not over-react to visual abilities and/or tactile abilities of any student.

I am reminded of a student with whom I have worked during the last two years. He had been classified blind and had used braille for his mode of reading. He was treated as a blind child yet had some useful residual vision. The boy was very sensitive and resentful of his

classification because he felt that he could see. He was bitter, negative, an academic failure, and in general not pleasant to be around. When the boy entered high school on probation in a special program, he was subjected to a program of vision stimulation. For the first time in the history of my contact with him at the academic level, he demonstrated enthusiasm and interest. He is doing much of his work with large type materials (not with adequate speed as yet, but useable). His attitude is somewhat better, and he has been placed in the regular program for some of his subjects. He asks many questions concerning what he sees. He spends time on his own between sessions, and does very well with other types of discrimination and identification. He is presently learning cursive writing.

That kind of vision training takes time. There is still much to be done with attitude and general acceptance of the problem on the part of this student. He is now better equipped to make a decision as to what media is most useful. He resists it, but he has been reminded that his braille skills should not be lost since he may need to rely more heavily on them at some future time.

Before an aid or mechanical device can be used, the child must learn "how to see" with his own "built in" equipment. Vision has a refining quality so any thing that comes in through the visual sense is important no matter how minimal the amount of visual stimulation may be. This requires <u>understanding</u>. The teacher can meet a great challenge by understanding the visual needs of a particular child and designing a prescription in a sequential pattern to help him develop all of his visual potential. The teacher must then be both <u>knowledgeable</u> and <u>flexible</u> in order to meet the needs in this diagnostic-prescriptive type of teaching.

The teacher must be willing to try something new or different if conventional methods have not led to completing the job adequately. This necessitates the collection of a variety of materials from which to choose and which can be manipulated to carry out various plans or perhaps an improvisation. Thus, the teacher is <u>responsible for supplying or creating materials</u>.

One of my students who was very interested in cars was having difficulty remembering letter formations. We threw out the flash cards and writing exercises which had been planned and brought forth some pictures of various kinds of cars with accompanying printed identification. He was very interested in figuring them out

and was soon copying the names. The list was cut apart and by reading his own writing, he was able to match the name and the picture. This allowed practice in several areas at the same time and did not seem to be a primary activity for a high school boy. The stimulation of finer visual discrimination and discerning likenesses and differences, as well as the use of symbol representation were somewhat the same as those in the original lesson.

Keeping current with attitudes as well as events enables the teacher to use the experiences, interests, and abilities of each individual child so that he will be better able to interpret the world through his own eyes and with his own thinking. This may require knowledge of the latest advertisements, toys, music, and things of this nature. The opportunity to tune in on his present environment is very important to his future development.

The mention of attitude brings to mind another important point -- the attitude of the teacher. Is the teacher accepting of the handicap? Is the teacher encouraging even though the way is difficult and the struggle great? Does the teacher set honest goals and encourage a realistic point of view for the student with low vision? These are only a few questions we might ask ourselves when considering attitude. The student very often reflects the attitude of the teacher. It is not wise to impose something on the student which will make him a lesser person. The student will set goals for himself which may or may not be practical. The teacher must regulate these goals so that they are attainable and honest goals for that particular individual. Constant encouragement is sometimes necessary. Where minimal amounts of residual vision exist, the work may be tedious and difficult at times.

I am reminded of a student who had been working very hard to discriminate differences and to identify objects. We had discussed what she might expect to accomplish and the difficulties which she might encounter. During a vision training session, she said, "I can't see it real well and it takes time to decide what it is, but remember when I couldn't even find the thing on the desk?"

If the student can appreciate what vision he has and realize his own improvement, he is better able to cope with the problem and work on his own. It is useful

to keep folders containing work or samples of work done. Periodically show the student how his work has changed and improved. Some students need only a small amount of guidance and practice, and when they learn the techniques which help them most, show vast improvement in efficiency of use.

The teacher is responsible for planning each session or series of sessions and must regulate or limit the intake and flow of materials with consideration for the limiting qualities of the individual handicap. When the child starts training sessions, he may need very short periods of training and frequent eye rest until the eye has learned to function and be used. Change in activity can sometimes provide rest and alleviate frustration. If the initial activity seems to be too difficult during a particular session, a different approach may be in order. The approach may simply extend the number of steps in a particular sequence or require use of additional and/or different material.

The role of the teacher during prescriptive teaching is supportative but leading. The student must be motivated because, as with most things, nothing can be accomplished if there is no interest or desire to discover. The student and teacher form a team. A problem sometimes arises when one is training two or three students at one time. It is most desirable to work with one student at a time, but often not practical in school situations. The interested student can assume responsibility for some of his own activity, or activities designed to help two or three at the same time may be used. This is particularly true in using games or flash cards. Blackboard activity lends itself nicely to such a situation.

Communication between the student and teacher can be a learning situation for both. Diagnosis and prescriptive teaching cannot be done if that communication does not exist. The teacher must see through the eyes of the student by listening, asking questions, and observing. Each of these things is equally important. A student with whom I have worked revealed that he was not seeing many things in the classroom because he needed much more light. With experimentation and communication I could help him to understand that more light striking the objectwas needed for him to be able to distinguish the details. This enabled him to discriminate and identify more. He is also color blind in some color areas which does not allow colors to provide cues. In another instance, I learned many things about fixation from a student who had eccentric vision and with whom I could communicate.

The teacher is responsible for the physical environment. This includes lighting, proper desk tilt or positioning of work, blackboards and chalk contrast, music stands, bulletin boards, and things of this nature. Lighting is particularly important and must be regulated for each individual student. Orderly storage of materials in a clearly marked fashion enables the teacher to have the flexibility needed to make sudden changes or to meet a momentary or unexpected need. A student may indicate that he does not know what some object under discussion looks like and the object or a picture needs to be produced at that moment if possible.

Records and frequent reports are very necessary. The whole series of training sessions are developed from observations and interaction with the student. When working with more than one student, it is difficult to remember accurately without notes and reports. Projected ideas should also be noted as they occur while the student is being observed in an activity. They are a great help in future planning. Should a student be absent or have a day, as sometimes happens with low vision, when a cold, an allergy, or other physical problems interfere with the manner in which the child is able to function visually, a record is most important.

The role of the teacher in charge of helping an individual student with low vision develop all of the efficiency possible is rather demanding. Such a teacher cannot be a timekeeper or clockwatcher. This teacher cannot be a "textbook wired for sound", as Bishop Sheen so aptly put it. The diagnostic-perscriptive type of teaching which we have been talking about demands that the teacher be receptive to the immediate and future needs of an individual, special kind of handicap and that she guide the student with these needs so that he might be able to function as efficiently as possible.

The teacher deals with the "whole child", with all of his deficiencies and efficiencies. To help him develop realistic goals, they should work out a perscription together and begin. The purpose is to reduce the burdensome character of the handicap. The process increases the individual's ability to make a successful adjustment to new and ever changing visual demands. Good learning can be a joyful experience which makes each day an enjoyable one.

PREPARATION FOR LOW VISION CHILDREN IN THE INSTITUTE

Part of the preparation for the Institute involved the selection of nine children with low vision. Applicants were asked to indicate if they worked with children whom they thought might qualify and who might benefit from the brief vision training sessions. Contact was made with the teacher and parents. Three children were selected from those suggested by teachers. Two children who had had some vision training at Illinois Braille and Sight Saving School were also selected. The remaining four children were enrolled in the Metcalf Laboratory School of Illinois State University.

Provisions were made to house seven of the children - two boys and five girls - at the Illinois Soldier's and Sailor's Children's School from Sunday through Thursday of the second week of the Institute. A cottage was made available to the seven children and three counselors. The dining hall, recreational facilities, health service staff and other personnel and facilities of ISSCS were made available.

Three majors in the area of the visually handicapped were selected to serve as counselors to the children on a full-time basis. Recreation was planned and directed by a member of the Illinois State University summer staff. The accompanying schedule of recreational activities indicates the variety. Bedtime was usually preceeded by a snack and stories.

It is quite possible that the greatest benefits of the Institute were derived by the seven children who shared the five days' experience. Several had never been away from home or parents. They found new friends among the other children and counselors and went home with pleasant memories of both new and familiar experiences. Of course, all of the children had some low vision training. Teachers who were participants in the Institute began to consider change from day school to residential school programs for two of the children. Both have now been admitted to Illinois Braille and Sight Saving School.

It was a new experience for the Department of Special Education to set up a short term diagnostic-teaching center and to provide the necessary living and recreational accommodations and supervision. The experience showed that it could be done successfully, providing benefits to children, parents, teachers and future teachers.

LOW VISION INSTITUTE

Childrens' Recreational Activities -- ISSCS

Sunday	July 19	5:30	Picnic at South Campus (ISU) Marshmallow roast, singing.
Monday	July 20	9:30	Trip to Miller Park Zoo and playground. Possible ride on locomotive. Refreshments.
		3:45-5:00	Bicycles of all sizes (including training wheels) reserved for use. Bike Shop.
		7:15-8:30	Swimming, ISSCS Pool.
Tuesday	July 21	3:30-4:30	Arts and Crafts activity at ISSCS A & C Shop.
		6:00-7:00	Go Carts Meet at Bike Shop.
Wednesday	July 22	3:30-4:30	Gym Variety of games and equipment available.
		7:15-8:30	Swimming ISSCS Pool.

CLINICAL SETTING AND CASE STUDIES OF LOW VISION STUDENTS

The goal of the Institute was to provide many avenues for understanding of the theory, methods, and selection and manipulation of materials in the stimulation of low vision and development of functioning visual efficiency. A clinical setting was established so that participants could actually experiment with some of the ideas which had been projected. Seven children were selected to become an integral part of the Institute schedule during the second week. Two additional students were in attendance during morning sessions only.

The participants in the Institute were divided into five groups of two and two groups of three. Each of the five groups of two was assigned to a student. The two groups of three were each assigned one student on a full time basis and an additional student during the morning sessions only. In one instance, participants worked with the two students together since the children were about the same age and could receive the individual observation and attention required. In the other group of three participants, one participant worked with the one part-time student while the other two participants continued with the full-time student. This proved to be more successful since the two students differed in age and were not compatible otherwise.

The participants heard all reports on the children, each taking particular note of the one assigned to him. In this manner, all participants became acquainted with every student. Date of birth, visual acuity, brief ocular report on the eye condition, grade in school, and other factors which might be pertinent were made known.

Each group was assigned a designated working area which was made as private as possible. This was necessary so that the individualized diagnostic-prescriptive type teaching could be as effective as possible on such a short term basis. Desks, extra lighting, bulletin board space, and blackboard space were made available in most of the designated work areas. A total of seven hours were scheduled over a period of four days during the second week - one hour the afternoon of the first day and an hour each morning and afternoon during the next three days.

Participants were asked to evaluate the existing visual efficiency or ability to discriminate during the initial session. Each group was provided with either the

Holmes or Barraga Visual Discrimination Test since the finalized copies of the Visual Efficiency Scale were not yet available. This was done to ascertain a point of departure and direction for the remaining sessions of visual stimulation.

The instructor made brief observations in each group during almost every working session. For the most part, one participant of each team did the teaching while the other observed. On some occasions it was found to be useful for the team to alternate with the initiation of each new activity rather than for each session. A daily report, Figure 1, was filed with the instructor between sessions. This afforded an opportunity to make comments and/or suggest changes in activity, direction, presentation of appropriate materials and speed of progression in the sequential pattern.

Time was allowed for evaluation, planning, selection of appropriate materials from the display table or making of materials such as geometric flash cards or figures, silhouettes, and pictures. Materials could be designed to meet a particular or individual need. Each participant had been given a list of suggested materials to bring to the Institute for occasions such as these. Included in this list were:

1. Several picture type magazines such as Life, Look, or Better Homes and Gardens.
2. Two or three newspapers.
3. Four to eight inserts from paper towel rolls (cardboard centers).
4. One package of black construction paper.
5. One package of multi-colored construction paper.
6. One fine-line felt-tipped black pen.
   One heavy-line felt-tipped black marker.
7. One bottle rubber cement.
8. One pair scissors.

The children with low vision were a selected group. Their ages varied from seven to eighteen years. All of the students had visual acuities of 20/200 or less, thus were classified legally blind. Some of the students had had formal training in which their vision served as the

chief channel of learning while others functioned as braille students. In at least two cases, there were complicating factors where the visual process was involved.

The following reports on each student involved in the Institute include pertinent information, brief summaries of the types of activities presented, general reactions and abilities of the student, and evaluations of progress from the participant reports.

FIGURE 1

DAILY REPORT

Name of Student_____

Names of Participants_____

Date_____ Time_____

Assigned Tasks (give approximate time spent doing each task):

Student Response:

Participant Comment:

Proposed activity and/or material for next session:

Case #1

Sex: Female

Date of Birth: 9/57 Age: 13 years

Grade Placement: EMH

Eye Condition: Optic atrophy - cause undetermined

Prognosis: Stable

Visual Acuity:

	Distance SC	Near SC
RE	20/800	14/224
LE	20/400	14/224
OU	20/400	14/225

	Distance WC	Near WC
RE	20/800	14/224
LE	20/200	14/224
OU	20/200	14/225

Other Pertinent Information: This student is functionally retarded. She functions at the upper limits for placement in classroom for Educable Mentally Handicapped. Inability, at least in part, seems to be due to her lack of exposure to both factual knowledge and dealings with everyday practical and social situations. She has been in a print program but has started to learn braille. It is indicated that she has not had a proper diet.

Results from a Visual Discrimination Test indicated that this student was able to distinguish between items requiring a rather fine degree of discrimination. She showed some confusion with blue and purple, but otherwise demonstrated good color concept. As her eye patterns were observed, it was determined that she did not always seem to use the same eye. Neither seemed to be dominate nor did she use binocular vision.

Ability to track or follow patterns adequately with finger or pencil was inconsistent as was following patterns with the feet. Poor eye-hand and eye-foot coordination was revealed during work periods, especially where fine motor skills or balance were required. Exercises directed to developing better coordination were adapted. She was attentive in a one-to-one-relationship and was able to follow directions as they were given. There appeared to be carry-over from day to day. She tended, however, to move quickly and not to be observant of her environment. She was easily disturbed and distracted. Indication was given that when there was difficulty in identification of items, simple pictures, or items in pictures, it was hard to tell whether it was because of lack of experience or visual acuity. Responses to visual stimulation did not seem to be consistent.

It was felt that this child had made some progress during this short period of visual stimulation and that additional training was indicated in order to fill in the gaps that seem to exist and to develop consistent visual patterns that could be more meaningful in her everyday existence. According to the report of participants, there seemed to be poor sense of balance, swinging of left leg while walking, and difficulty was demonstrated in picking up small objects with left hand. Further work in the development of adequate eye-hand coordination and eye-foot coordination was indicated.

Case #2

Sex: Female

Date of Birth: 3/2/63 Age: 7 years

Grade Placement: Completed first grade - promoted to the second

Eye Condition: Aniridia - OU
Congenital Cataract LE

Prognosis: Poor

Visual Acuity:

Distance

RE	20/200	
LE	below 20/200	no improvement with glasses
OU	absent	

Other Pertinent Information: Both parents are visually handicapped so there is little or no emphasis on visual activity in the home. Her intelligence is average to above average. She has been functioning in a room for partially seeing. She was referred with excessive reversal problems and has been subjected to one semester of special vision training sessions -- two hours per week. Marked improvement was shown, but difficulty is still indicated.

Though some vision training had been given to this child prior to the Institute, a re-test with the Holmes Visual Discrimination Test indicated a continued tendency to reverse and to be inattentive to details. Use of the right eye was observed, and as the work became smaller, closer scrutiny was necessary. More complicated tasks took a longer time.

This student was very cooperative and worked well throughout the instruction times with only brief eye rest

until a cold caused greater fatigue and lethargy. Discrimination was good when time was taken to "look" at the entire picture rather than fixating on an item and hurrying to the next or needing reminders to look more closely. She seems able to correct her mistakes. She tended to omit details and demonstrated limited experiences. Puzzles, picture study, sequence story cards, spatial relationship, writing, and drawing exercises were all part of the planned work for this student. Spatial and environmental study were also included.

It was recommended that this child continue work in vision training. A great deal of work using inner detail, figure-ground, color and line cues or clues (puzzles), direction, and background visual experience was recommended. It was suggested that she works too fast for accuracy and without really looking. Establishing visual habits and patterns emphasizing careful discrimination and identification seem important.

Case #3

Sex: Female

Date of Birth: 6/8/58 Age: 12 years

Grade Placement: Special Placement -- ungraded, approximately 6th grade

Eye Condition: Optic atrophy
Convergent Strabismus
Nystagmus

Prognosis: Stable

Visual Acuity:

Distance

RE	HM	Fixation changes with
LE	HM	different lenses.
OU	Not determined	No glasses.

Other Pertinent Information: This student is functioning in the dull normal range, according to the WISC. There is brain damage resultant from injury at the age of five contributing to coordination problems as well as conceptual and perceptual problems. Cardiac arrest resulted in optic neuritis. Physical therapy treatments have been given and one year of the Doman-Delacoto treatment was administered.

This student was exposed to a Visual Discrimination Test with no concrete results except with color. These were all identified correctly except one. Because of complicating problems in the entire vision process and lack of any type of coordination, concrete, solid objects in simple geometric designs were tried. Blocks were identified and correctly labeled as round or square at approximately two feet. She was able to match colored squares or knew when they did not match or were the same size.

She did not seem able to cross over the mid-line when tracking. Coordination of eye and hand was not successful in tracking with any consistency. She knew left and right, but failed when asked to transfer to two-dimensional figures.

The participants working with this student felt that progress was made, particularly in attitude. It was indicated that development of more efficient use of the existing vision is possible. Tasks should be geared to her level of accomplishment. More work in the areas of fixation, pointing with her own finger (eye-hand coordination), and tracing an outline or tracking was recommended.

Case #4

Sex: Male

Date of Birth: 1962 Age: 8 years

Grade Placement: Just finished second grade, going into third grade

Eye Condition: Microphthalmos
Congenital Cataracts

Prognosis: Unknown

Visual Acuity:

	Distance WC
RE	20/300
LE	LP
OU	20/300

Other Pertinent Information: This boy functions above average and is in a braille program.

This boy completed the Holmes Visual Discrimination Test in a period of 15 minutes with only one error, indicating good use of existing residual vision where these items were concerned. Animal cards, picture cards, and outlines were all used. He was very alert, eager, confident, and at ease throughout the sessions. He used his right eye and fixation was good. He put his glasses lens right on the work when the item or print became smaller. The capital letters of the alphabet proved to be easy. He made only two errors on lower-case letters.

The activities included Cuisinaire Rod puzzles, matchettes, word cards, picture story and picture study, coloring and print reading in various sizes, and writing

exercises. The boy indicated interest and demonstrated that learning was taking place. He functioned with a great deal of visual efficiency.

It was recommended that this student should continue in a vision stimulation program. It is felt that he should be able to use his vision as much as possible and that he should have the opportunity to make the choice as to which medium he should use.

Case #5

Sex: Male

Date of Birth: 9/10/62 Age: 8 years

Grade Placement: Completed second grade
Promoted to third grade

Eye Condition: Amblyopia
Congenital Mystagmus
Esotropia
Hyperopia
Secondary Condition: Congenital Strabismus

Prognosis: Poor

Visual Acuity:

Distance SC	Distance WC
Cannot be determined	RE Counts fingers 3 feet LE Counts fingers 2 feet OU Not determined

Near:

RE Poor fixation
LE Cannot fixate

Other Pertinent Information: There was a Taner brain defect at birth which has affected the eyes. He has average to above average intelligence and is assigned to a print program. He has had a year of vision stimulation in a special class for two hours a week.

The participants who worked with this boy reported as follows: the Visual Discrimination Test indicated a deficiency in line and form discrimination and reproduction of figures, particularly words. Reassessment at end of seven sessions indicated the ability to discriminate form and lines which he failed on the first test. Since he had more light on the subject at the second time, it is

difficult to know whether the difference was due to more light or greater ability to look for discriminating features.

After working on line and form, he showed improvement on the second day.

While the scale did not show deficiency in color discrimination, he did have problems. Three sessions giving some time to color showed some improvement. He had no trouble with primary colors, but had real trouble with secondary colors and shades and values. The last session showed improvement in this. He was having trouble with blue-red spectrums.

He had trouble with picture representations of animals. Once certain discriminating features were taught, he remembered how to use them. We started with large pictures. By the last session he could identify most of the animals on the small cards, a size equivalent to reading workbooks.

He enjoyed the form board. He worked it three times -- the first session required twenty minutes. He wanted to follow immediately with another "try." He did it in half the time because he began to see the kinds of shapes needed to fill the space. He was allowed to do it again twenty-four hours later to check on carry-over. He obviously used what he had learned the day before. Time required was approximately five minutes.

There is every evidence that he will continue to benefit with visual stimulation.

Case #6

Sex: Female

Date of Birth: 8/9/52 Age: 18 years

Grade Placement: Senior during the past year, graduated June 1970

Eye Condition: Marked Hyperopia
Astigmatism

Prognosis: Probably stationary

Visual Acuity:

Distance SC

RE less than 20/200
LE less than 20/200 Glasses not indicated
OU none indicated

Other Pertinent Information: Psychological examination indicated that she has superior intellectual ability. She intends to attend college in the fall of this year. She has had cataract surgery and there has been recurrence in the right eye.

This girl was able to complete only one item on the first page of the Visual Discrimination Test. The left eye seems to be the better eye since a cataract is recurring in the right eye. It was found that subdued light was better since more light hampered the use of any residual vision. Dark glasses were used indoors. Light objects on white backgrounds enabled her to discriminate much more quickly. She demonstrated no color concept but distinguishes between light and dark. Her sight helped her some in walking.

This student was asked to place her finger in the center of a square and did so. This was great progress

from the first session. She was able to track and denote changes or differences in direction. She was able to identify the hour-glass figure and some basic animal figures. These were made and mounted by a participant. The student indicated that it was shocking to her that she was able to use her vision and improve as much as she had.

There was definite progress indicated in this short period of time. It was recommended that vision stimulation be continued with this student. Continued training in Orientation and Mobility, as well as Daily Living Skills, should be practiced more industriously.

Case #7

Sex: Female

Date of Birth: 1964 Age: 6 years

Grade Placement: First grade

Eye Condition: Congenital amaurosis
(lack of central vision)

Prognosis: Unknown

Visual Acuity: Not determined

Other Pertinent Information: The teacher indicates that this student travels well and seems to see form. She does have light perception.

This child was unable to complete any of the Visual Discrimination Test. She reacted to strong sunlight, covering her eyes. When using regular room lighting, she was able to locate the source. Light directly on the work area seemed to help.

This case was a great challenge since the vision was extremely low. There was a complete lack of visual experience which indicated that fixation had to be established first. Finding a light and following it along with use of visual search in a spatial setting as well as on the gross geometric form were projected. She began to think more of using her eyes. It was felt there was probably no eye-hand coordination or no eye dominance because of lack of experience.

Activities such as a road-way tacked on the bulletin board with a sucker as the prize at the end of the road

were used to direct visual development. She was beginning to track with her eyes rather than "sneaking in" a tactile method. Hand held on tasks seemed easier when using white on black paper.

The participants observed some progress, although not a large amount. It was felt that she would probably benefit from further training.

Case #8

Sex: Female

Date of Birth: 1966 Age: 4 years

Grade Placement: Kindergarten

Eye Condition: Congenital Glaucoma

Prognosis: Poor

Visual Acuity:

OU Light Perception

Other Pertinent Information: This little girl is shy. The teacher indicates a possibility of larger form perception and color. There is good mobility.

This little girl was only in attendance for three sessions. A Visual Efficiency Scale had previously been administered.

It was discovered that she needed to have the material at a distance of approximately two inches. She did not use a pattern of scanning but could discriminate likenesses and differences in large gross forms. She used her right eye when working and looked directly at the examiner. A point of focus seemed to be established and colors identified. She did not appear to be visually curious.

This child was able to do shape and color puzzles with little difficulty. Some of the difficulties she encountered could have been due to experiential gaps. She indicated that she could learn to use her vision and it was recommended that a visual stimulation program be continued.

Case #9

Sex: Male

Date of Birth: 1963 Age: 7 years

Grade Placement: Unclassified, approximately first grade

Eye Condition: Bilateral Optic Atrophy

Visual Acuity:

RE Finger vision 10 feet
LE Finger vision 5 feet
Future evaluation is recommended

Other Pertinent Information: This boy has mild cerebral palsy. He has been receiving physical therapy treatment. A Visual Efficiency Scale had previously been administered.

This boy was highly distractible with a short interest span. He seemed to put little effort into the visual task yet was correct much of the time. He tired easily of the task. He indicated in rod and block play that he could discern differences in height, but did not initiate the arrangement.

He attended three hour sessions, and since he was not compatible with the group or more than one teacher, a place with more privacy and one teacher was provided.

This participant reported, "This boy seemed to respond well visually but did mention Braille. He has a psychological need to have definite bounds established. He has questionable color vision and it would be well to determine the extent of his color handicap on an ocular report

since many primary materials are based on color. He should be treated as a sighted child with much visual stimulation. I feel that this child needs to have several sessions to get to know an instructor before the scale is finished."

EVALUATION

The final session of the Institute was devoted to evaluation. A brief period of time was spent in discussion relating to general aspects of Special Study Institutes and the role of the University in such in-service experiences. An evaluation form was presented to participants and time was allowed for completion during the session. An abbreviated outline of the evaluation follows:

I. Lectures
   - A. Time allowed
   - B. Sequence of presentation
   - C. Variation in presentation approach (Each topic and name of person making the presentation was listed)

II. Work with children
   - A. Time allowed
     1. Preparation time
     2. Working with children
   - B. Method of assignment
   - C. Observation
   - D. Exchange of ideas

III. Materials
   - A. Variety and type
   - B. Availability

IV. General comments

The following comments, suggestions, and recommendations have been summarized from the discussion and written evaluation form:

General reaction to the Institute was most favorable. It was felt that it was practical and very worthwhile. It was generally considered to have been well planned and organized.

Several participants found it to their advantage to receive credit for the Institute. It was suggested that it might have been offered on a Pass-Fail basis and that the assignment of letter grades could have been eliminated.

Time allowed for the entire Institute was considered appropriate. It was adequate in length for presentation of a great deal of information but short enough to prevent lag, to be stimulating, and to hold the interest of the participants.

It would have been beneficial to have had a bibliography sent prior to the Institute. Participants could have had an opportunity to do some preparatory reading. Reading would have provided background for more immediate understanding of the lectures and would have contributed to better group discussion. A reference list would have encouraged participants to bring materials or books pertinent to the subject from their own libraries.

All the lectures received favorable comment. Dr. Barraga was held in high regard and the information she imparted was felt to be most useful. It contributed greatly to general understanding. Dr. Guth's lecture on "Light and Lighting for the Visually Handicapped" was considered to be very comprehensive and informative. For some it was difficult to follow because it was highly technical. Overall, it was well received. The reviews of anatomy, refraction and diseases of the eye were good and much appreciated by many. It was felt that they were quite technical at some points and included too much material. Most participants felt the need of Dr. Merrick's "refresher." Dr. Farrar presented informative demonstrations and lectures. The participants appreciated the opportunity to use and handle the aids in the large display assembled by Dr. Farrar and Mrs. Fagerstrom. The impact made by Mrs. Fagerstrom as an example of someone who could adequately and successfully use low vision aids was tremendous.

Greater opportunity for discussion would have been desirable. Though there was time set aside for discussion, additional time between lectures might have been utilized. Discussion during the period of teaching in the clinical setting would have brought out individual problems. Some time at meals and in the dormitory was devoted to informal discussion which was good but undirected.

The opportunity to work with children was considered the highlight of the Institute. Participants felt that the Institute would have been less effective had there been no children involved. Most participants suggested more time devoted to work with children. However, they felt that the one hour sessions set aside for vision training were too long for the children. Several shorter sessions would have been more desirable. Participants could have made use of more time for planning and preparation of materials for the vision training sessions.

Participants would have felt more secure about working with the children if there had been some opportunity to observe an experienced person in vision training sessions. Use of video tape was suggested as a medium for such observations when a "live" training session was not feasible. Several felt that more observation of low vision children should have preceeded the participants' work with the children and should have been interspersed with the practicum experiences. The participants expressed the desire to observe the children as they functioned outside the clinical setting. (Participants were invited to do so but the need to complete their papers prevented it.) Most participants expressed a particular desire for more time to observe the child with whom they worked, both in the clinical setting and in other activities.

The participants felt a need for comprehensive evaluation of their work with the children. They would have liked some feedback following each session. Since the experience was new and they worked with children for such a short time, it was difficult to evaluate their own approach and the child's success.

As mentioned earlier, discussion between training sessions would have been beneficial. Such discussions might have provided an exchange of ideas and materials, a sharing of problems, and description of various kinds of visual behavior and activities. Again, greater use of video tape was suggested. Tapes of individual children could have been utilized for group discussion, as well as to provide information to the individual instructor. In some instances, behavior was revealed in viewing a video tape which was missed during the actual training session.

A reading and work room containing materials and a place to work to develop materials was suggested. The materials available were considered excellent. The opportunity to experiment with them and evaluate them seemed to be another highlight of the Institute.

A final suggestion was that a short follow-up Institute be held at a later time, approximately a year later.

BIBLIOGRAPHY

Books on reserve at Milner Library.

The following bibliography was presented to participants in the workshop. It was intended for their use as a guide to supplementary reading during the two week Institute and as a source of references for the preparation of the final paper.

Allport, F.H. Theories of Perception and the Concept of Structure. New York: Wiley & Sons, 1955.

Barraga, N. Increased Visual Behavior in Low Vision Children. American Foundation for the Blind, Research Series, 1964, No. 13.

Bateman, B.D. Reading and Psycholinguistic Processes of Partially Sighted Children. Council for Exceptional Children Research Monographs, 1963, Series A, No. 5.

Bier, N. Correction of Subnormal Vision. London: Butterworths, 1960.

Fields, J.E. Sensory training for blind persons. The New Outlook for the Blind, 1964, 58, 2-9.

Fonda, G. Management of the Patient with Subnormal Vision. St. Louis, Mo.: Mosby, 1965.

Gesell, A. Ilg, F., & Bullis, G. Vision--Its Development in Infant and Child. New York: Harper, 1950.

Gibson, E.J. Principles of Perceptual Learning and Development. New York: Appleton-Century Crofts, 1969.

Gibson, J.J. The Senses Considered as Perceptual Systems. Boston: Houghton-Mifflin, 1966.

Goins, J.T. Visual Perceptual Abilities and Early Reading Progress. Chicago: University of Chicago Press, 1958 (Monogr. No. 87).

Hebb, D.O. The Organization of Behavior. New York: Wiley & Sons, 1949.

Herm, R.J. Limited vision and low vision aids - the ophthalmologist's view. In American Association of Instructors of the Blind, Forty-seventh Biennial Convention. Watertown, Mass.: American Association of Instructors of the Blind, 1964. Pp. 31-32.

Hirsch, M.J., & Wicks, R.E. (Eds.) Vision of Children, an Optemetric Symposium. Philadelphia, Pa.: Chilton, 1963. (Chapters 2, 4, 5, 8, 10, 14, 17).

Hunt, J.M. Intelligence and Experience. New York: Ronald, 1961.

Inhelder, B., & Piaget, J. The Growth of Logical Thinking from Childhood to Adolescence. New York: Basic Books, 1958.

Jones, J.W. Blind Children Degree of Vision Mode of Reading. Washington, D.C.: USGPO, 1961. (OE-35026, Bulletin 1961, No. 24).

Jones, J.W., & Collins, A.P. Educational Programs for Visually Handicapped Children. Washington, D.C.: USGPO, 1966. (OE-35070, Bulletin 1966, No. 6).

Juurmaa, J. Ability struction and loss of vision. American Foundation for the Blind, Research Series, 1967, No. 18.

Kabrisky, M. A Proposed Model for Visual Information Processing in the Human Brain. Urbana, Ill.: University of Illinois Press, 1966.

Lowenfeld, B. Psychological problems of children with impaired vision. In W.M. Cruickshank (Ed.), Psychology of Exceptional Children and Youth. Englewood Cliffs, N.J.: Prentice-Hall, 1955. Pp. 214-283.

Montessori, M. Dr. Montessori's Own Handbook. New York: Bentley, 1914.

Nolan, C.Y. Blind children; degree of vision, mode of reading: A 1963 replication. In Council for Exceptional Children, Inspection and Introspection of Special Education. Washington, D.C.: Council for Exceptional Children, 1964. Pp. 86-94.

Orton, S.T. Reading, Writing, and Speech Problems in Children. New York: Norton, 1937.

Piaget, J. The Origins of Intelligence in Children. New York: International Universities Press, 1952.

Segal, A., & Stone, F.H. The six year old who began to see. In R.S. Eissler (Ed.), The Psychoanalytic Study of the Child. Vol. 16, New York: International Universities Press, 1961. Pp. 481-509.

Smith, H.P., & Dechant, E. Psychology in Teaching Reading. Englewood Cliffs, N.J.: Prentice-Hall, 1961.

Smith, W.O. The visual system in reading and learning disabilities. The Journal of School Health, 1969, 39, 144-50.

Vernon, M.D. A Further Study of Visual Perception. New York: Cambridge University Press, 1952.

Zahl, P.A. (Ed.) Blindness: Modern Approaches to the Unseen Environment. New York: Hafner, 1962.

The following periodicals which appear on the Bibliography and Materials List concerning Utilization of Low Vision may be found in Milner Library on the Illinois State University campus.

American Foundation for the Blind Research Bulletin
American Journal of Orthopsychiatry
American Journal of Psychology
American Psychologist
British Journal of Psychology
Children
Exceptional Children
International Journal for Education of the Blind
Journal of Abnormal Social Psychology
Journal of Developmental Reading
Journal of Education
Journal of Experimental Education
Journal of Experimental Psychology
Journal of Psychology
New Outlook for the Blind
Psychological Review
Review of Educational Research
Scientific American
Sight Saving Review

A copy of the Utilization of Low Vision Bibliography and Materials List was made available to participants from the Instructional Materials Reference Center for Visually Handicapped Children at the American Printing House.

SPECIAL STUDY INSTITUTE

METHODS AND MATERIALS FOR TRAINING

LOW VISION SKILLS

VIDEO TAPES

The following video tapes are available for use in the Special Education Instructional Materials Laboratory at Illinois State University. They have been produced on Sony V-32 1½ inch video tape for use on Videocorder and monitor.

Copies of the tapes are available on loan from the Instructional Materials Center for Handicapped Children and Youth, 1020 South Spring Street, Springfield, Illinois, 62706

77. Merrick - Basic Internal Anatomy and Physics of Refraction -- Implications for the Education of the Visually Handicapped.
Time -- Approximately 60 minutes.

78. Merrick - Diseases of the Eye as Related to Low Vision.
Time -- Approximately 60 minutes.

79. Farrar - The Visual Examination, Classification, Description, and Basic Design and Principles of Low Vision Aids.
Time -- Approximately 50 minutes.

80. Farrar - Selection of Low Vision Aids and Adaptive Training.
Time -- Approximately 45 minutes.

81. Guth - Light and Lighting for the Visually Handicapped.
Time -- Approximately 45 minutes.

82. Holmes - Methods and Materials With Low Vision Children.
Time -- Approximately 20 minutes

and

Barraga - The Total Visual System -- Developmental Aspects of Functional and Perceptual Visual Abilities.
Time -- Approximately 40 minutes.

83. Barraga - The Total Visual System (continued).
Time -- Approximately 60 minutes.

84. Barraga - Attitudes and Psychological Factors -- Basic Principles of Training Activities for Low Vision.
Time -- Approximately 50 minutes.

85. Barraga - Assessment of Visual Functioning Level (VES)
Time -- Approximately 60 minutes.

86. Barraga -- Assessment of Visual Functioning Level (continued) and Development of Prescriptive Models for Activities with Low Vision Children.
Time -- Approximately 45 minutes.

87. Barraga - Development of Prescriptive Models for Activities with Low Vision Children. Time -- Approximately 50 minutes.

The following video tape is not available for loan but copies will be prepared by Illinois State University if interested persons furnish the tape.

ISU 260 Holmes - An Appraisal of Visual Efficiency.
Time -- 42½ minutes.

AUDIO TAPES

Audio tapes of the Institute presentations are available for use in the Special Education Instructional Materials Laboratory at Illinois State University. They are also available on loan from the Illinois Materials Center for Handicapped Children and Youth.

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